POWER

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Will We Muddle Through?

IT IS NATURAL that those who have not lived through or been seriously affected by a former period of extreme depression should begin to do something more than wonder.

When one sees values crashing with no takers at the broken prices, banks and business houses failing, factories shut down or running at fractional capacities, stores to let, and thousands out of employment, and when these conditions go on from months into years, with no signs of improvement, one is apprehensive that something has happened to our social system and that our organization for a collectively advantageous reaction to our environment is breaking down.

George Bernard Shaw in reply to the question whether we shall muddle through, reminds us of civilizations once as promising as ours which are now known only to the student of ancient history, and says that the stability of a civilization depends finally on the wisdom with which it distributes its wealth and allots its burden of labor.

There is no physical reason for deprivation, on any extensive scale, of the necessities or even of the conveniences and enjoyments of life. Our natural resources are still abundant, and man was never so well equipped to win and fabricate and advantageously distribute and employ them.

We are a long way from that tragic moment when, as has been pictured, the few survivors of a cooling planet will battle with one another for the few remaining heat units. We are far from being ready to realize the dire prediction of Isaiah, "And the earth shall wax old as a garment, and the people thereof shall die."

But we have not got far enough away from the peurile, selfish attempts to better conditions which are typified by that of the barbers of a certain country which are announced by recent news prints to be seeking legislation to prohibit the importation of safety razors to offset a defensive movement toward self-service on the part of their customers.

EDITORIALS

Save the Power Pennies

BUYING Power When It Should Be Bought.

Making Power When It Should Be Made.

These are two of the eight principles that *Power* stands for. And to them might well be added another: Saving Dollars Where They Should Be Saved. There are people who may say this precept is so obvious it is trite. But is it? Certainly there are many otherwise-efficient industrial executives who constantly belie their capacity as dollar-savers by allowing good money to trickle through their fingers in the administration of their power needs.

No factory or industry manufactures its product without using power, and no manufacturing executive lasts long who does not spend time, energy and money in plant system and machinery where it will save dollars in the cost of production. A few cents a pound saved in the purchase of raw materials, or a few minutes cut from manufacturing time, are assiduously striven for and the whole staff is keenly stimulated to watch for loopholes affecting the unit cost of the finished article.

Now the production of power is no less than a manufacturing process. The raw materials are coal and water; boilers, pumps, turbines, engines and generators are the machines. Kilowatt-hours and pounds of steam, are the finished products. Why then is it that the saving of the power dollar gets so little attention in so many cases?

When asked this question, some have countered with the argument that power is such a small percentage of the total cost of manufacture that its cost, within reasonable limits, is of little effect. And their power houses are neglected accordingly.

Does the efficient industrial business live on percentages or dollars? Which pays the dividend? There is no doubt about the proper answer. Yet there is factory after factory where this philosophy is not extended to the question of power.

Some are making it where they should not. Many are buying it where they should not. Others can make it less expensively than they do.

Let them all give more consideration to their power problem, if they will reduce the cost of manufacturing their finished products. Let them forget the percentage idea. It is the dollars that count.

Boiler Circulation Research Needed

NOT SO VERY LONG AGO engineers believed that circulation in a boiler was well understood and no longer presented a problem to boiler designers. The advent of water walls, higher ratings and greater pressures so materially changed circulation conditions that today boiler design presents a very different problem. Many now admit that little is actually known of what goes on in the water circuit of a modern boiler equipped with water walls.

A recent report concerning the operation of a straight inclined-tube boiler with three horizontal cross drums illustrates this lack of knowledge. Feed water is admitted to the two outer drums and steam is taken from the center drum, as the designers expected its water level would be low so that it would act also as a dry pipe.

Observations proved, however, that the center drum water level was consistently high, and wet steam was being discharged to the superheater. Furthermore, it was found that at low ratings the water level in the rear drum was low when a normal water level was carried in the front drum, and that this condition reversed at high ratings. A better understanding of boiler circulation would have made it possible to predict such action and design accordingly.

The bibliography of research in the May 26 number of *Power* indicated that some research on this subject is in progress, but it is of such importance to successful boiler operation, that it warrants more extensive work than is now under way.

Flue Gases Effective for Mill Drying

MOISTURE WAS LONG a troublesome factor in the pulverization of coal. The earlier methods of drying the raw coal by means of rotary driers, flue-gas stationary driers and steam driers of various types have been generally superseded by mill drying. The pulverizing mill is now furnished with air or gas, preheated to such a temperature that the moisture

is evaporated and absorbed from the coal during its pulverization in the mill.

In the direct-fired system preheated air is used in the mill and the air-coal dust mixture passes directly to the furnace. Fresh supplies of preheated air are furnished to the mill to do the drying. No vents are necessary. The dust nuisance from vents is thus eliminated. All the preheated air eventually finds its way to the furnace, and while some of its heat has been lost in evaporating the moisture in the coal, this may be partially offset by the beneficial catalytic effects of this moisture as vapor in accelerating combustion in the furnace.

When the central system of coal drying is used, the procedure is different. To keep the humidity of the carrier air that circulates through mill and cyclone below the dew point, it is necessary to vent a certain portion of this air to the atmosphere. Thus a part of the preheated air is not completely utilized in the sense that it is not returned to the furnace. The vent discharge carries some coal dust, which constitutes a nuisance about the plant if not properly washed.

Instead of using preheated air, it is the practice in some cases to withdraw a quantity of flue gas from the breeching at a point where the temperature ranges from 500 to 600 deg. The quantity need not be large. The vent from the circuit can be carried back into a following section of the breeching. Moreover, it is then possible to supply all the preheated air to the furnace and any dust is thus discharged with the stack gases.

The system is simple, cheap and effective and seems a good method of operation for plants employing the central system of coal pulverization.

Engineering Education—A Market Problem

MANUFACTURERS must sell their products. For that reason consumer demand, measured in sales, must ultimately determine the productive activity of their factories.

No such natural limitation is imposed on the engineering schools, "manufacturers" of graduate engineers. Regardless of the demand, it is possible for them to accept students up to the limitations of facilities, faculties and funds. The market itself imposes no limitation, except in cases where the school chooses to be guided by it.

Granting that the human raw material is theoretically able to adjust itself to the demand, the resulting control is clearly ineffective. May one reasonably expect a high school graduate to evaluate even the present demand for men trained in a given branch of engineering? It would certainly be a miracle if he could predict this demand four years in advance. What generally happens is that the boy is fond of engines or motors or bridges, and therefore decides to be a mechanical, electrical or civil engineer. Without guidance in selection there can be little relation between supply and demand even in normal times.

Right here a question arises. Is there, in normal times, an oversupply of engineers? Some say "no," and point to the yearly competition of large manufacturing companies who send scouts to the campus to pick up the best men. Others say "yes," and present as evidence of oversupply the low average salary level of engineers, and the fact that—year after year—there are more experienced engineers looking for jobs than there are jobs looking for such men.

But whichever answer is correct, colleges face a market-study problem. Is it not clearly the duty of the engineering schools—working independently, or through such an agency as the Society for the Promotion of Engineering Education—to take this situation in hand, study the present and potential market for engineering graduates, and then so present the facts to each prospective student that he can intelligently adjust his inclinations to economic conditions.

Nobody expects either the engineering schools or the S.P.E.E. to select careers for high school graduates, but is it not their responsibility to give authentic information and expert advice so that none need choose blindly?

It could not reasonably be claimed, of course, that any such market survey made four years ago could have predicted or prevented the specific situation facing the graduates of this June. With the demand gates closed by business depression, we find 145 technical colleges pouring out 10,000 engineering graduates, of whom 5,000 are electrical. No magic formula will solve the problem of these men. Time will ease their condition, but for the present they find themselves innocently entangled in a situation that affects all industries and occupations—a situation not to be predicted or prevented by any survey made in 1927.

Yet would not the problems of this year's graduates be less acute if output had been adjusted to normal demand? And, in normal times, would not such adjustment benefit the whole profession, assuring an active demand for the services for all competent engineers, accompanied by enhanced prestige and greater earning power?

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POWER Stands for . .

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**
8. **Prevention of Smoke, Within Reason**

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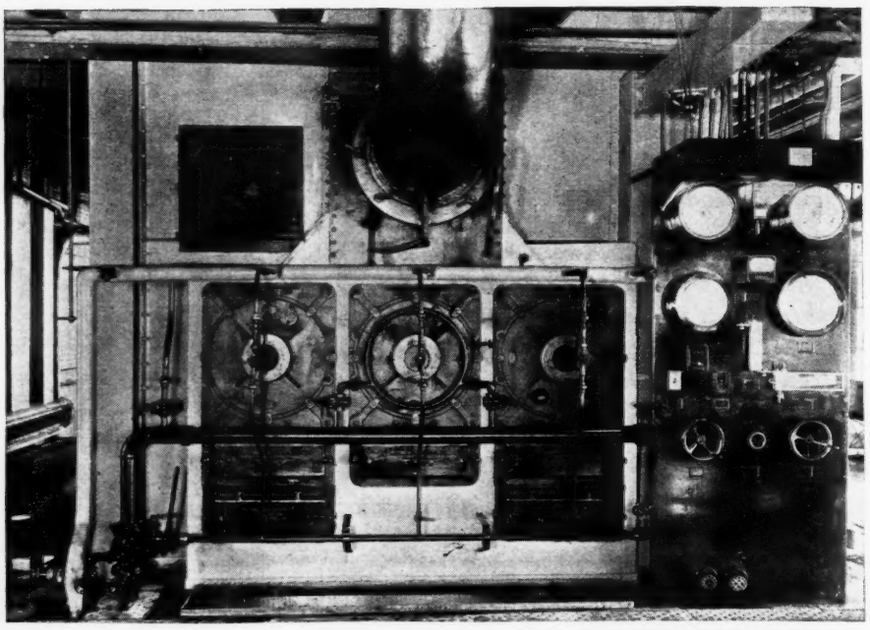


Boiler front, showing arrangement of coke, oil and gas burners and complete boiler control

Operation With Refinery Waste Fuels

By J. H. DUBENDORF and J. F. HUITT
Shell Petroleum Corporation

Provision is made to burn simultaneously five different fuels at the Houston refinery of the Shell Petroleum Corporation. Without economizers or air preheaters, monthly average efficiencies of 78 to 80 per cent are maintained. Petroleum coke gives results 3 per cent better than oil and 5 per cent higher than gas. The operation is discussed.

WHEN THE Houston refinery of the Shell Petroleum Corporation was projected, the latter part of 1928, engineering experience was called upon to develop a plant with some rather unusual features. These included ability to burn all kinds of refinery waste fuels, high ratings considering the large percentage of make-up water, high efficiencies without economizers or air preheaters, low exit-gas temperatures and low draft loss at high ratings, low maintenance costs, dependability and flexibility.

The first requirement was a continuous and dependable supply of steam at sufficiently high pressure and temperature for process work. Balancing the cost of distributing to various units throughout the refinery at relatively low pressure against the cost of generating at relatively high pressure, it was decided that a pressure of 200 lb., with 200 deg. F. superheat, would give the lowest over-all cost.

Depending on the operation of the refinery units, the steam demand varies, but normally ranges from 80,000 to 120,000 lb. per hour, with an average of 90,000 lb. The load factor for the six months ending Sept. 30 last averaged 67 per cent.

A second major requirement was clean steam. It was believed that this could be controlled by correctly treating the boiler-feed water, without the employment of other means.

Provision has been made to burn refinery waste fuels such as coke, gas, cracking plant residue, fuel oil, acid sludge, tank bottoms, etc. There is an ample supply of coke and gas available and these two fuels are burned almost continuously, while residue oil, acid sludge and tank bottoms are burned as produced. Oil is used as an emergency fuel and for firing cold furnaces not equipped with gas burners. The five different fuels may be burned simultaneously, if desired.

Although the refinery is along the Houston ship channel, which is fed by some fresh water streams, the channel water is not suitable for boiler feed where a large percentage of make-up is required, so it was neces-

TYPICAL ANALYSIS OF BOILER FEED WATER

	P.p.m.	Gr. per Gal.
Silicon dioxide (SiO_2)	20.3	1.19
Iron and aluminum oxide (R_2O_3)	5.3	0.31
Calcium carbonate ($CaCO_3$)	47.2	2.76
Magnesium carbonate ($MgCO_3$)	20.5	1.20
Sodium carbonate (Na_2CO_3)	150.8	8.82
Sodium sulphate (Na_2SO_4)	49.1	2.87
Sodium chloride ($NaCl$)	68.4	4.00
Total solids (by analysis)	361.5	21.15
Total solids (by evaporation)	381.3	22.30

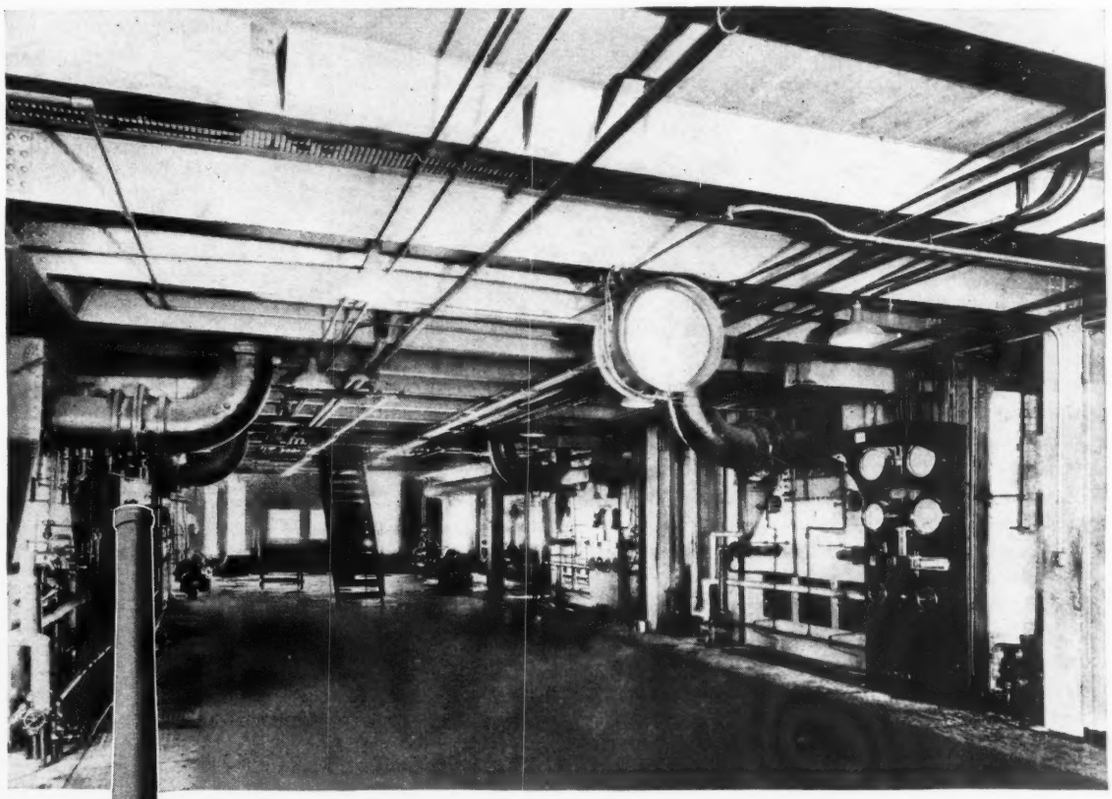
sary to obtain the boiler-feed water from deepwells. A study of the analysis of water from different strata in this territory, ranging in depth from 200 to 1,400 ft., indicated that water from a depth of 400 to 500 ft. would be more desirable, so the feed water is taken from that stratum. The accompanying table gives a typical analysis of this water.

It will be seen that the water should be treated for the removal of carbonate hardness and to establish the correct sulphate alkalinity ratio to protect the boilers from possible caustic embrittlement. Hydrated lime ($Ca(OH)_2$) and dead burned gypsum ($CaSO_4$) are used in a hot-process softener to obtain the desired results.

Five 5,470-sq.ft. Stirling-type boilers designed for 250 lb. working pressure are installed. The stacks, pumps, piping and heaters all are designed for an ultimate installation of eight boilers of that size, while the building, which will now accommodate one additional boiler, is designed for extension. Both side and rear furnace walls are water-cooled, with refractory-faced water-wall tubes. The furnace floors, air-cooled, slope from front to back.

All piping was installed with a minimum of flanged joints. Tube turns and welded connections were used wherever possible. The steam and feed-water headers are of the ring design. Two complete system of boiler-feed piping are provided and each boiler has a feed-water regulator.

Petroleum coke, the principal fuel, is transferred from storage to a track hopper in side-dump cars. An apron conveyor delivers the coke to a crusher, which discharges the crushed material into a bucket elevator. The elevator feeds a belt conveyor that delivers the coke into hopper bottom bunkers. From the bunkers the crushed coke is passed over automatic weighing scales into the unit pulverizers, where it is pulverized and discharged by an integral exhauster fan to the burners. Magnetic separation of "tramp" iron from the fuel is effected before the fuel is delivered to the crusher.



In this firing aisle notice the unobstructed view of all boiler fronts and controls and the easy accessibility to auxiliary equipment

Exterior view of the plant, showing stack and breeching arrangement, coke-handling equipment, and outside sedimentation tank of hot-process water-treating system

Three of the boilers have two oil burners each, while the other two have three. There are two gas burners for each of two units and one gas burner is provided for a third boiler. Gas piping is common to all units, and openings are provided in the front wall of each furnace so that gas burners may be installed, when desired, in those units not so equipped.

At the rear of one of the boilers there is a furnace extension in place of the rear water wall. A rotary sludge burner is placed outside the boiler house and arranged to discharge the products of combustion into this furnace projection. The sludge is dumped into a near-by concrete pit and is delivered from the pit into the burner by a specially designed inclined scraper conveyor.

To reduce the fire hazard to a minimum was the principal reason for locating the sludge burner outside the building. Also the burning of this waste fuel is accompanied by some spillage in handling, which is undesirable inside the boiler room.

A control panel is conveniently located at the right-hand front corner of each boiler setting. All necessary instruments and controls, to allow the operator to adjust and regulate the operation of the unit, are mounted upon this panel. Steam generation and distribution is metered by indicating, recording and integrating meters. Each unit is equipped with a complete set of flow meters, CO_2 meters, temperature recorders and draft gages.

Work on the boiler plant was started in January, 1929, and the first boiler was placed in service June 25 of that year. The work was carried out, with few exceptions, by the regular construction force of the Shell Petroleum Corporation under joint supervision of the Baumes-McDevitt Company of St. Louis, who designed the plant, and the Shell Petroleum Corporation's engineers.

Operation Experience and Instruction

In operation it has been found that, with few exceptions, men take more interest in their work when they are fully informed as to the relative importance of their duties. An organized class meets one afternoon each week and a systematic course of study and instruction is given. Complete operating records are kept and the results of each shift are recorded separately.

Special attention is given to handling and preparation of fuels. The relative merits of the available fuels have been studied for the purpose of determining which could be used with best results. It has been found that pulverized petroleum coke is the most desirable fuel from an operating point of view and that the boiler and furnace efficiency obtainable with coke is higher than that obtained with any of the other available fuels. The higher efficiencies are obtained only when the coke is pulverized to the necessary degree of fineness, which can be controlled, within reasonable limits, by regulating the volume of carrier air admitted to the feed end of the pulverizers. Samples of coke are taken from the discharge lines between the exhauster fans and the burners at regular intervals and tested in a standard fineness tester. The manufacturer's guarantee of 75 per cent through 200-mesh screen is obtainable when the hammers are not too badly worn.

Monthly average efficiencies of 78 and 80 per cent are obtained while firing coke with reasonably high ratings and with a spare boiler held up to pressure at all times. It seemed wise to carry a spare boiler under pressure to take care of any extra steam demand that may be created by unusual operating conditions in any of the various refinery units. The average efficiency obtained with coke is about 3 per cent higher than that obtained with oil, and 5 per cent higher than with gas. Significant data recently collected from a boiler fired with petroleum coke are given below:

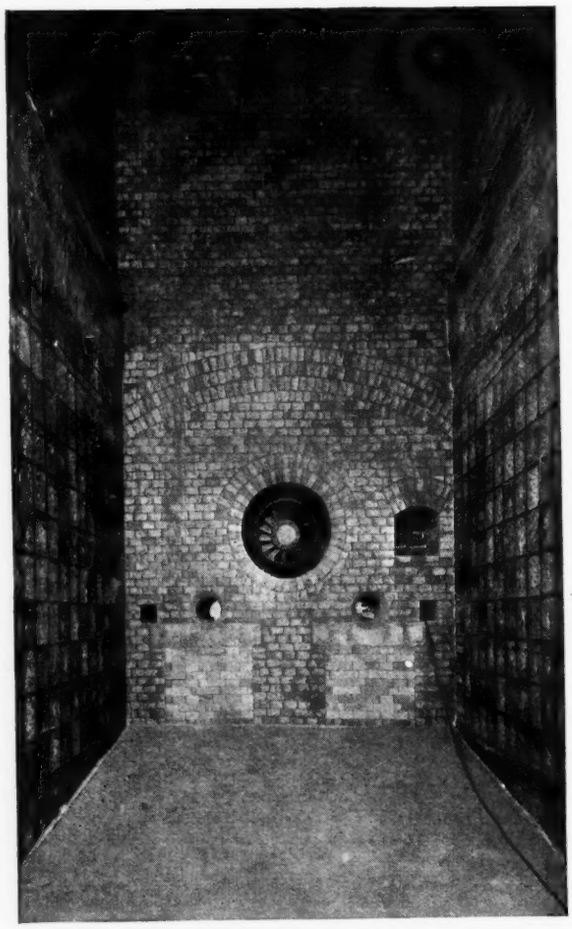
Boiler ratings, per cent	260
Furnace temperature, deg. F	2,800
Uptake temperature, deg. F	480
Steam pressure, lb. gage	200
Steam temperature, deg. F	590
Steam quality from drum to superheater, per cent drys	99.58
Total solids in boiler water, gr. per U. S. gal	540
Draft loss between furnace and uptake, in. water	0.62
Per cent CO_2 in stack gases	14.5

In the water-treating plant treatment is controlled by titrations made in the boiler plant. Samples of treated water are taken at two-hour intervals. The raw water is sampled at twelve-hour intervals and a sample is taken from each operating boiler once a day. Composite samples of raw, treated and boiler water are submitted to the chemical laboratory each month for complete analyses. The laboratory report of the analyses is used to check the determinations derived from the daily titrations made in the boiler plant.

Some calcium silicate scale, resulting from the silicon dioxide and calcium carbonate remaining in solution in the treated water, has formed on the internal surfaces of boilers operating at high ratings, and a supplementary treatment to prevent the combining of these impurities is necessary. Di-sodium phosphate is now being used with good results.

Samples of condensed steam are submitted to the chemical laboratory for analysis at regular intervals. The sample analyses show that the steam is of excellent quality. The steam headers that carry the steam from the boiler drums to the superheaters are equipped with sampling tubes to which a steam calorimeter may be attached. Proper control of feed-water treatment effectively maintains constant quality steam with 0.5 per cent or less moisture.

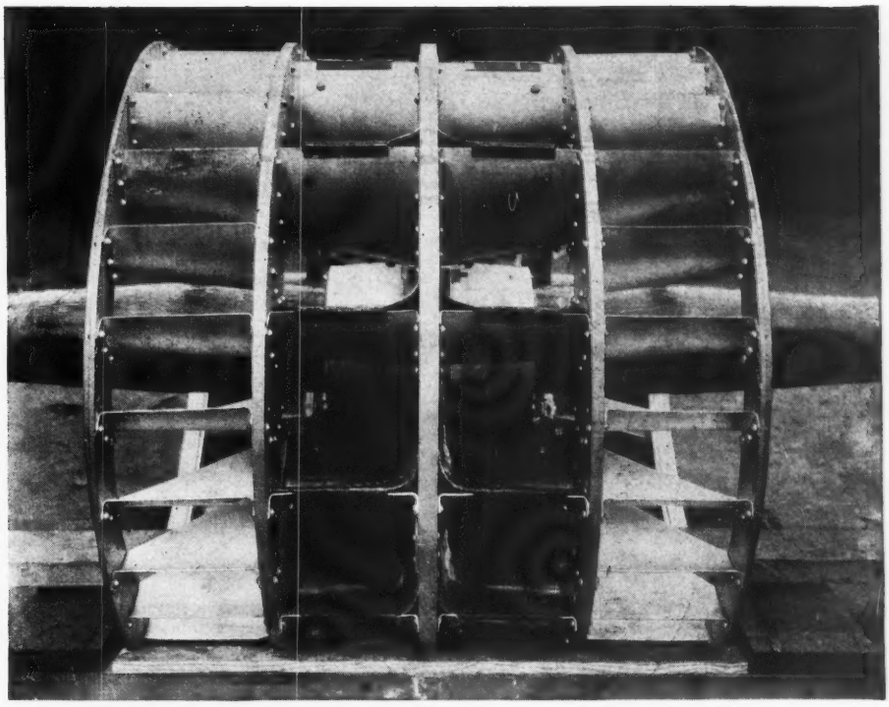
Units are taken out of service at regular intervals for thorough inspection of boilers, furnaces and appliances. Pumps and other auxiliaries are inspected periodically and minor repairs are made when necessary. Unusual maintenance costs resulting from improper operating methods are discussed freely with the operators and ways and means of correcting the troubles are worked out. This procedure, together with complete maintenance records, has resulted in minimum outage of equipment and comparatively low maintenance costs.



Showing coke and oil burner arrangement in front wall from interior of furnace

By A. B. STICKNEY

Engineer,
Fred Ophuls and Associates



"Half-soles" hook over outlet edges of fan blades

"Half-Soles"

SOLVE FAN-EROSION PROBLEM

LESS PUBLICITY has been given to the erosion of induced-draft fans by pulverized-fuel ash than the seriousness of the problem warrants. While it has always been a factor, the burning of fuels high in abrasive ash accentuates its importance to a point where it may be a governing factor in keeping the plant in operation.

A case in point is the new Anheuser-Busch power plant, which was described in the June 17, 1930, number of *Power*. To meet the initial condition of excessive wear on their fans, Prat-Daniel Corporation, the manufacturer, developed a system of cheaply replaceable wearing surfaces which reduces maintenance to small proportions.

In this plant the ash amounts to 20 per cent of the coal, and is of a very abrasive nature, as determined both by experience and microscopic examination. The high induced draft required increased the abrasive effect on the fan blades. Momentum carries the ash entering the sides of the fan to the center disk of the rotor, where it is turned radially by concentration and impact. Therefore on the initial rotors wearing strips were welded to the blades adjacent to the central disks. This construction had previously proved effective with the same make of fan.

After a relatively short period, inspection showed that the fan blades were cut through by the ash at the edge of the wearing strip. Impact at this point dug a radial channel, and the central disk was also badly worn.

The use of manganese steel blades, or stelliting at the point of wear, doubled the life of the rotor, which was further increased by baffles on the shaft to deflect the ash flow and distribute the wear over the blades.

The final solution, however, was found in a removable wearing blade, or "half-sole," shown in the photograph, which covered the inner blades, and presented a smooth curved surface near the center disk, thus offering no right angle corners or cracks for concentration of the dust stream and resultant cutting, and at the same time protecting the surface of the central disk from wear by impact.

Experience shows that these "half-soles" will outlast the fan as originally designed with wearing strips, that the rotor itself will last indefinitely, that the "half-soles" are readily replaced without removing the rotor from the casing, that they can be built so as not to upset the balance of the fan, that there is a slight decrease in fan capacity with this construction, and that the maintenance cost with this system is a small fraction of what it was before.

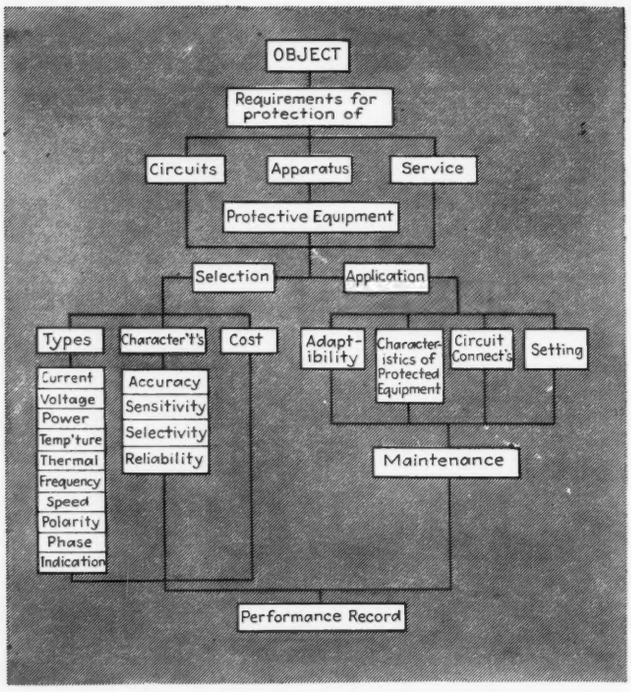


Chart showing all the steps in the evolution of a carefully planned protection procedure

By H. D. BRALEY

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The WHAT and HOW of Electrical Protection

Damaged equipment, extended interruptions to power supply and production are the result of faulty protection to electrical equipment. In this, the first of a number of articles on protection of electrical machines and circuits, requirements of protection, type of protective equipment and how it should be applied are considered

IT IS generally recognized that a certain amount of protective equipment is necessary to guard circuits and machines against abnormal conditions, but the selection and application of suitable devices may not always be known. Where one is confronted with this problem the questions naturally arise:

1. What are the requirements?
2. What type of protective equipment should be used?
3. How should it be applied?

It is intended to answer these questions with particular reference to industrial installations. Before proceeding with a detailed discussion of protective schemes it may be well to consider the broader aspects of the subject in order to establish some of the fundamentals and thus secure a clearer perspective.

Object of Protection—In a sense, electrical protection is a form of insurance, a protection against possible life hazard or damage to equipment in so far as such contingencies may be foreseen. Its function, in most cases, is to disconnect faulty equipment from the system before injury to the operator or extensive equipment damage can occur, and to do this with the least possible disturbance to service. In some instances it may be desirable for protective devices only to sound an alarm or give other signal. For example, to indicate overheating of a motor where service continuity is more important than protection of the motor against damage.

Requirements—With the object of protection clearly in mind, primarily the minimum requirements that must be satisfied in any case should be established. The minimum requirement for any protective system is that it shall safeguard life. This may be direct protection to effect that result or it may be by indirect means—for example, to prevent fires or explosions that might constitute a life hazard. Protection against this is required for all circuits, rotating machinery and sometimes for the service itself. In many cases the required protection against life hazard will also fulfill the minimum require-

ments dictated by economic considerations for circuits and apparatus, although the type of protective equipment may vary widely. A fuse may be the only protection required for a circuit against fire hazards, but economic considerations or engineering practice might require an automatic circuit breaker. The National Board of Fire Underwriters and the National Electric Code regulations have been set up primarily to safeuard life and property against fire hazard by establishing rules governing the installation of electric circuits and apparatus in buildings. These are generally recognized in this country as the minimum requirements for safety. Automatic protective equipment covered by these regulations concern chiefly the overload protection of circuits, appliances and rotating machinery. The main points covered by this code as applied to apparatus, circuits and service are here given and these may be taken as the minimum requirements to safeguard life:

Circuit Protection—Circuits in buildings must be safeguarded in three principal respects:

1. Automatic disconnecting equipment, such as fuses or automatic circuit breakers, to protect against overload or short circuit.

2. Grounding of low-tension circuits in excess of 150 volts to ground to protect against voltages which may be hazardous to life or property.

3. Construction and installation by approved methods which are intended to minimize the possibility of equipment failure and to provide safeguards against accidental contact with live parts. Additional precautions are required in hazardous locations where volatile liquids, inflammable gases, combustible dust or easily ignitible fibers, flyings, etc., are handled, manufactured, stored or used.

Apparatus Protection includes:

1. Automatic disconnecting equipment, such as circuit breakers or fuses, to protect against overloads and short circuits. Note: (Overload protection not required for alternating-current generators.)

2. Protection against dangerous overspeeding of motors by automatic devices in their control if overspeed protection is not inherent in the machine's design.

3. Means for disconnecting both motor and control to insure safe working conditions when repair, maintenance, and other work is being done on the machine.

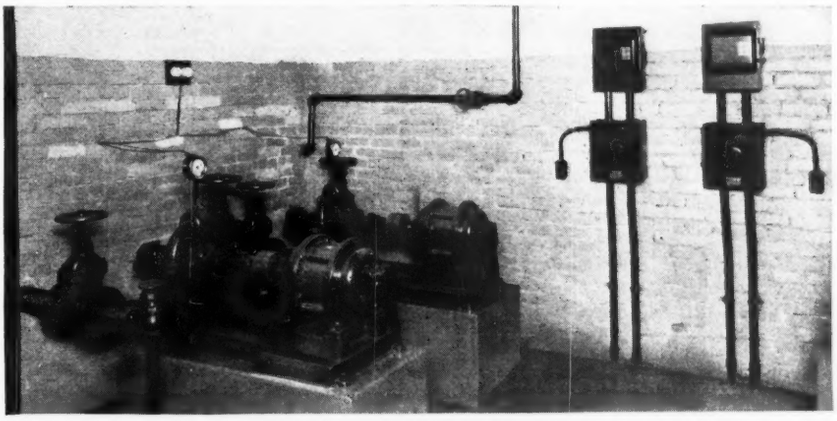
4. Protection against unexpected starting of machines to avoid accidents to operators or other personnel. The two principal safeguards used are: (*a*) location of control for group drives so that all machines are within sight of the control's location, and (*b*) no-voltage protection on motor control to disconnect the motor from the line when it stops due to voltage failure, thus preventing the motor from restarting when line voltage returns, unless the control is restored to the start position.

5. Grounding of machine frames that operate at potentials in excess of 150 volts to ground, unless inaccessible to unqualified persons.

6. Protection against phase reversal on polyphase alternating-current motors, operating elevators, cranes or similar devices where an unexpected reversal in direction of movement would be hazardous.

7. Construction of approved type to guard against unqualified persons making accidental contact with live parts where the potential above ground exceeds 150 volts.

Service Protection—Service protection is, in a broad sense, any means that may be taken to insure its continuity. Many factors, such as materials, design, construction, operation, maintenance and others, affect or control the continuity of service. With all the precautions that can be taken it is not possible to safeguard a single service so as to guarantee against failure. Where such failure constitutes a life hazard, additional safeguards must be provided. This can be done by maintaining a reserve that is instantly available if the normal service fails.



Safety switches, inclosed automatic starters with thermal overload protection, and push-button control insure safety to the attendant and the motors

Service protection should therefore be provided where a failure of the normal service causes a condition hazardous to life. This protection may be had by providing independent circuits to separate services, each supplying a portion of the load, or, by switching equipment, to transfer the load to a reserve if the normal service fails.

Other Requirements—Aside from life-hazard considerations, additional or higher-grade protection may be justified from an economic aspect or as a matter of convenience. Economic justification for protective equipment should properly be considered on the same basis as insurance, as it is insurance against property damage, loss of production, lost time, and, in some instances, damage to product being fabricated.

Protection is economically justified in any case where its cost is less than the loss that would otherwise result were the protection not provided. Protection cost is a definite quantity easily determined. On the other hand, losses that may result from the absence of protection are not readily determined in advance of their occurrence. It is not possible to predict the damage that may result from fire, accident or disease, but long experience and careful analysis by insurance companies enable them to predict the probability with a close degree of certainty. These possibilities are affected by several modifying factors. Fire probability is influenced by the type of con-

struction and the nature of work conducted within or adjacent to the premises. Life insurance is concerned with age, nature of occupation, state of health and other factors. These factors properly affect the insurance premium paid for protection.

Experience must also be a guide in determining electric-circuit fault probability and the resulting damage or other loss if a fault occurs. As in other types of insurance, consideration must be given to factors some of which have been previously indicated in connection with requirements to protect against life hazard. It is also known that the application of proper protective equipment may limit the damage or service interruption to a minimum. These factors will be discussed in later articles with reference to the various types of circuits, machines and services illustrative of the practices which experience and careful analysis have shown to be justifiable to provide the necessary protection.

In addition to requirements for safety and those dictated by economic reasons, in some instances it may be found that further refinements in protection are desirable simply as a matter of convenience. This is generally a measure of what one may be willing to pay for service. For example, fuse protection of a lighting circuit in a private residence fulfills all safety requirements, and, in most cases, economic requirements. However, it may be desirable to install a small automatic circuit breaker that can be instantly reset to restore service and eliminate the inconvenience of searching for spare fuses. Similar reasons may prevail for the protection of a machine in a factory or shop.

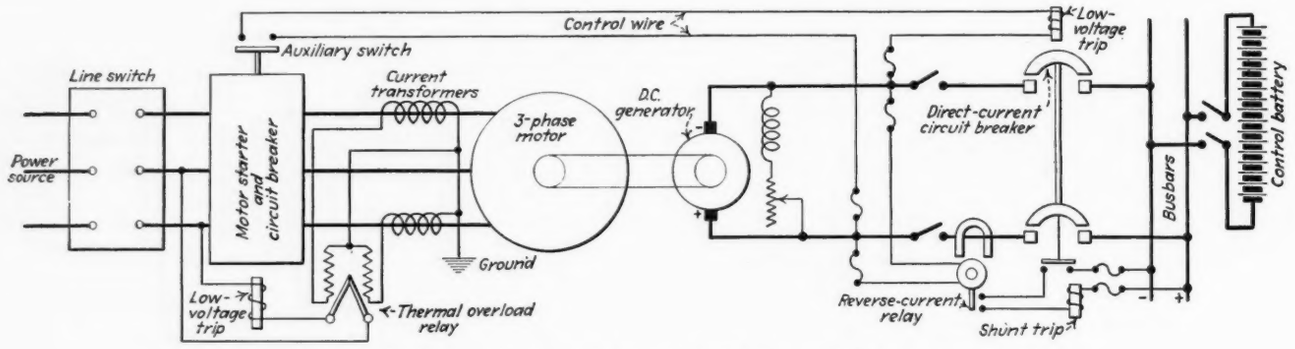


Diagram of protection of motor-generator for charging a control battery illustrates the five elements of protective apparatus mentioned at the end of this article

Selection and Application

Following the determination of requirements, the next important step in protection procedure is selecting equipment and applying it to a particular job to attain the desired results. Selection and application may be considered the parents of any protection family. The chief qualifications of this couple should consist, primarily, of an engineering knowledge of equipment available and its adaptability to the problem at hand; a thorough understanding of the operation or duty of the protected apparatus, and, finally, a large measure of common sense. Simplicity is an earmark of good engineering in any protective scheme. It is as important that no unnecessary equipment be used as it is to provide sufficient equipment.

It will be desirable to give attention to the characteristics of protective equipment in some detail to permit of a satisfactory selection and application. This discussion will be confined to the operating characteristics rather than to design details.

Accuracy, sensitivity, selectivity and reliability are the most important characteristics of protective equipment. While there has been some variance in definitions assigned to these characteristics, this is probable due to a choice of words rather than the intent to convey a different meaning. These qualifications may be defined for any protective device as follows:

1. *Accuracy*—The ability to consistently and accurately reproduce a certain operating performance.

2. *Sensitivity* — The characteristic of responding throughout its operating range to small changes in the elements or factors that govern operation, such as current, voltage, power, etc.

3. *Selectivity*—The ability to positively distinguish between a fault in the protected equipment and a fault in another part of the system.

4. *Reliability*—Design and construction of such a nature that it will always function as intended under a prescribed operating condition with a reasonable degree of maintenance.

The degree of accuracy, sensitivity and selectivity essential in any instance is determined largely by service importance. Obviously, the greatest possible perfection in these characteristics is not essential for protecting a comparatively unimportant circuit or small apparatus where adequate back-up protection of a higher grade exists. On the other hand, protection of large expensive machines or the main power circuits to a large plant will justify the highest grade of protective equipment. Reliability should not, however, be sacrificed no matter how unimportant the application. If the device is unreliable or requires constant attention to keep it in operating condition, it might better be dispensed with entirely Confidence in unreliable equipment is misplaced, and leads to a false security that may cause a dangerous condition, if not an accident.

Elements of Protective Apparatus

All automatic protective systems, ranging from the simple overcurrent fuse to the most elaborate systems, comprise part or all of the following elements:

1. The circuit-opening device, such as fuse, thermal cut-out, or circuit breaker.
2. A source of power for actuating the circuit-opening device.
3. Relays.
4. Instrument transformers.
5. Control wiring, indicating lamps, etc.

Consideration of these essentials will be useful in selecting and applying protective apparatus to specific uses and will be the subjects of future articles.

TEN-YEAR OPERATING RECORD OF THE LA CROSSE, KAN., LIGHT AND WATER DEPARTMENT

	Fuel Oil		Lubricating Oil		Repairs and Supplies	Labor	Total Operating Cost	Kw. Hr. Generated
	Gal. Used*	Cost	Gal. Used	Cost				
1921	42,495	$2,280.18	327	$151.91	$179.20	$3,129.60	$5,740.89	381,548
1922	43,779	2,199.90	388	189.00	465.34	3,780.00	6,634.24	407,568
1923	46,760	2,215.68	374	136.54	636.59	3,780.00	6,768.81	457,887
1924	49,452	2,264.07	447	198.40	120.73	3,780.00	6,363.20	515,453
1925	52,917	2,565.43	460	275.42	166.59	4,170.00	7,177.44	536,106
1926	61,815	3,663.75	639	290.06	150.62	3,630.00	7,734.43	589,899
1927	60,174	3,045.15	715	334.53	315.87	3,656.00	7,351.55	583,141
1928	72,528	3,076.89	665	322.73	174.44	3,600.00	7,173.56	629,936
1929	80,733	3,378.94	1,115	744.34	216.47	3,780.00	8,119.75	791,568
1930	84,325	2,302.21	1,405	806.96	53.40	3,750.00	7,002.57	864,926
	594,978	27,082.20	6,535	$3,449.39	$2,479.25	$37,055.60	$70,066.44	5,758,023

*Includes oil used for fuel station and office heating.

10 Years' Operation of a Diesel Plant

SUMMARY OF THE RESULTS

Kw. per gal. of fuel, 10-year average	9.67
Kw. per gal. of fuel, 1930 average	10.25
Total operating cost per Kw.-hr., yearly average, mills	1.21
Total operating cost per kw.-hr., 1930, mills	8.1
Repairs and supplies, yearly average for 10-year period	$247.92
Total revenue	$220.242.97
Total operating cost	70,066.44
Gross profit for 10 years	$150,176.53

RESULTS possible in a small diesel power plant under proper management and care are shown in the tables covering the costs in the La Crosse Kansas municipal power plant. As given in the summary, the average kilowatt-hours per gallon of fuel was 10.25 in 1930, and the ten-year average was 9.67. The better performance in 1930 was due to a better load factor and the more efficient performance of the present engines.

Originally this plant contained a 120-hp. two-cylinder horizontal semi-diesel engine, installed in 1922. Later the capacity was increased by a 60-hp. semi-diesel installed in 1926.

As the load increased a 330-hp. five-cylinder and 260-hp. four-cylinder vertical solid-injection De La Vergne diesel engines direct-connected to generators were installed, as was also an improved cooling-water system, including a storage tank.

Of especial interest is the repairs and supplies cost record, which over the ten-year period was less than one-half a mill per kilowatt-hour generated. This is unusually low and is indicative of the economy of having an efficient management and operating force.

The 330-hp. and the 260-hp. engines employ the Price combustion principle, in which the fuel is burned in a chamber in the cylinder head, with the result that the piston is partly shielded from the heat of the combustion reaction.

No air compressor is employed to inject the fuel, instead a pump forces the oil charge through two opposing nozzles at a moderate pressure.

The engine valves are in the combustion chamber and are operated by push rods from the camshaft, which runs along the frame at a level with the cylinder bases. Pressure lubrication is applied to all the main and crankpin bearings.

Creased Pipe Bends Offer Great Flexibility

By W. PAUL
Dusseldorf, Germany

IN MANY of the modern high-pressure, high-temperature power plants, in Germany, flexibility in the piping system is provided for by "creased bends."[1] Although this type has been used for several years in Europe, it is not particularly well known in America.

The creased bends are made in such a way that the actual bending occurs with the neutral axis in the outside surface of the bend; thus there is no thinning out of metal in the outer fibres of the bend. The extra metal at the inner surface of the bend is taken care of by the formation of creases in the pipe wall. In this way the dangers of stretching of material that occurs when making the normal plain bend is eliminated. Pipe bent to radii of three to four times its diameter shows a thinning of the outer wall amounting to as much as 34 per cent, whereas it is claimed that creased-type bends have a uniform wall thickness throughout. In addition, the creased bend avoids cross-sectional flexing. This is of considerable advantage, as A. M. Wahl's investigations have indicated that considerable stress is induced by internal pressure in pipe bends having initial ellipticity of cross-section, and that these stresses, when superimposed upon those due to bending, may result in stresses high enough to produce permanent stretch, with consequent reduction of expansion capacity.

Plain 90-deg. bends are generally bent to a radius of about five pipe diameters. Although with thick-walled pipe the bending radius may be reduced to three diameters. Creased bends, however, can be made with a bending radius as small as one and one-half times the pipe diameter. For the same face dimension, a short-radius bend has greater flexibility than a large-radius bend.

Tests made on various 90-deg. bends of $6\frac{1}{4}$-in. outside diameter seamless tubing with $\frac{3}{8}$-in. wall and having tangent lengths of $29\frac{1}{2}$ in. resulted in the following deflections

Bending Radius, In.	Deformation, In. Plain Bend Load 2,205 Lb.	Deformation, In. Creased Bend Load 1,764 Lb.
$8\frac{7}{8}$	.....	0.275
$11\frac{3}{16}$	.....	0.242
$17\frac{3}{4}$	0.140	0.148
$23\frac{3}{8}$	0.117	0.117
$29\frac{1}{2}$	0.078	.....

The deformation of 90-deg. creased bends in pipe of the same dimensions but under a load of only 1,764 lb. shows the greater flexibility of the small-radius creased bends. No permanent set occurred in any of the bends tested.

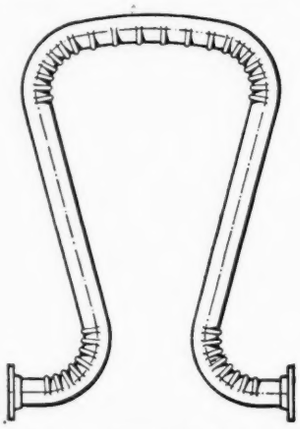


Fig. 2—Elliptical form of expansion bend avoids high stresses

The form of creased double-offset U-expansion bend is somewhat different from the conventional plain double-offset U-expansion bend, as it has been found that the top of the bend will be subjected to dangerous stresses. The elliptical form shown in Fig. 2 has been found satisfactory. The top of the bend is made with a comparatively long straight piece of pipe, because flexibility increases with increasing length, and the stresses in the material are decreased by the elliptical form.

To indicate further the flexibility of creased bends, the following calculation has been made for the turbine connecting pipe, shown in Fig. 1. This creased U-bend was designed for 782 lb. pressure at a temperature of 915 deg. A special high grade tubing of 22,757 lb. per square inch tensile strength at 915 deg., was used. The outside diameter of the pipe was 10.12 in., with a 33/64-in. wall thickness. The smallest possible radius to which a plain pipe bend could be made in this case was $28\frac{3}{8}$ in. For the creased pipe design a radius of $19\frac{3}{4}$ in. was chosen. The distance between the flanges was 4 ft. 9 in., and the average height or length of the tangents was 7 ft. 3 in. In spite of the considerable thinning out of the wall

[1]Patented in U. S. A.

Fig. 1—Creased-bend connection for a steam turbine

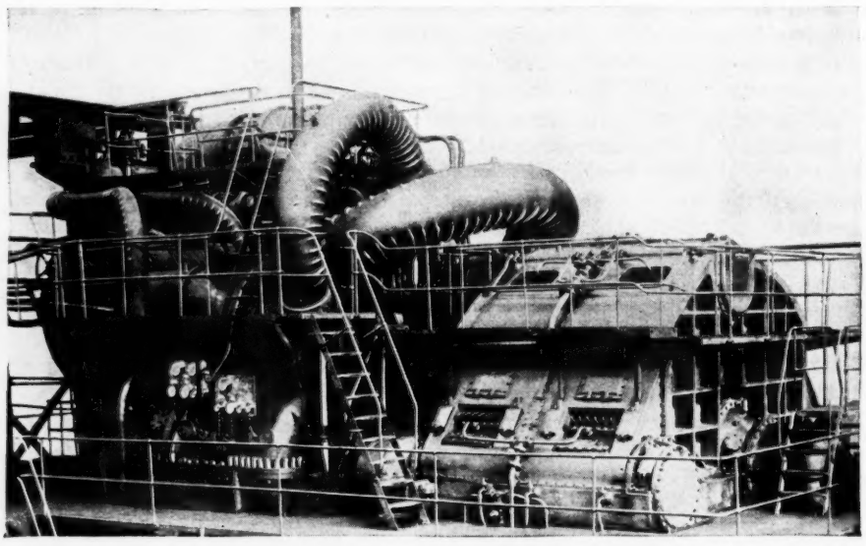


Fig. 3—Turbine and reduction gear installed on the S.S. Bremen

PRESSURE DROP FOR CREASED 90 DEG. BEND—LB. PER SQ.IN.

$R = 2 . D$	$R = 3 . D$	$R = 4 . D$
$\frac{v^2 . d}{427}$	$\frac{v^2 . d}{569}$	$\frac{v^2 . d}{902}$

v = velocity of steam, ft. per sec.
d = spec. weight of steam.

modulus has been taken as only 15 per cent, which is to the advantage of the plain bend.

The calculations were based on a required flexibility of 13/32 in., and resulted in the following: The anchor force for the creased pipe amounted to 1,650 lb., and that for the plain pipe amounted to 4,475 lb., the creased pipe bend had a factor of safety of 2.25, whereas the plain pipe bend had a factor of safety of 1.48.

The pressure drop due to steam flowing through creased tube bends is not as large as one might be led to believe, considering the irregular interior of the pipe. The resistance coefficient of an ordinary plain 90-deg. bend is, at a radius of 0.3 diameter, 0.05, and the coefficient of the creased bend is 0.08, indicating a 60 per cent higher resistance through the creased bend. If, however, the two bends are compared on the basis of equal flexibility, it will be found that the creased bend has slightly less pressure drop than will the plain tube bend, because of the somewhat greater length of pipe necessary in the plain type of bend.

Pressure-drop tests have been conducted in the power plant of a large European industrial concern, and from the results of these tests the pressure-drop equation given in the Table has been developed. The results obtained from the use of these equations appear to check closely with the results of the actual test.

In Europe creased bends have been used in connection with steam conditions of 1,422 lb. per square inch and 932 deg. F. The advantage of being able to make bends to a small radius is well illustrated in Fig. 3.

Operating Elevators to Reduce Passenger Waiting Time

By HOWARD B. COOK

WHEN thousands of dollars are being spent for additional elevators in buildings, to reduce the interval between cars by a few seconds, it is essential that the elevators be operated so as to reduce passenger waiting time to a minimum. During a recent test of an elevator installation a complete record was made of the passenger waiting time at the various floors. It revealed that if the intervals between cars had been constant, the average passenger waiting time would have been reduced.

Further study disclosed the important fact that irregular intervals increase the passenger waiting time in proportion to the square of the deviation from the normal interval, and the actual increase in average passenger waiting time is equal to the square of the deviation divided by twice the normal interval. The average time spent by a passenger waiting for a car is equal to one-half the interval between cars. For example, if the normal interval between cars is 36 sec., and if the flow of traffic is equal to an average of one passenger every 4 sec., then each car leaving the first floor will carry an average of nine passengers.

If the normal interval between cars is maintained, the total average waiting time of the passengers entering each car at the first floor is $18 \times 9 = 162$ passenger-seconds. A car leaving the first floor 12 sec. late would carry an average of 3 additional, or a total of 12 passengers. The average waiting time would be equal to one-half the interval, or $\frac{1}{2}$ of 48 sec., which is 24 sec. The total waiting time for the passengers in this car would be $24 \times 12 = 288$ passenger-seconds.

If the next car left on time it would leave after an interval of 24 sec. and would carry an average of 6 passengers. The average waiting time of these passengers would be 12 sec., and the total waiting time would be $12 \times 6 = 72$ passenger-seconds.

The total passenger waiting time for the two cars would be $288 + 72 = 360$ passenger-seconds. Since the normal waiting time is 162 passenger-seconds per car, or 324 passenger-seconds for two cars, $360 - 324 = 36$ passenger-seconds have been added because one car was 12 sec. late.

Should a car in the same bank of elevators be 24 sec. late, it would carry an average of 6 additional, or a total of 15, passengers. The interval between cars would be 60 sec., and the total waiting time of all the passengers in this car would be 450 passenger-seconds. If the following car ran on time it would leave 12 sec. after the late car, with an average of 3 passengers. The total waiting time of the passengers in this car would be 18 passenger-seconds, and the total passenger waiting time for both cars would be 468 passenger-seconds. This is 144 passenger-seconds more than the normal passenger waiting time for two cars, and this additional waiting time is four times that resulting from a lateness of 12 seconds.

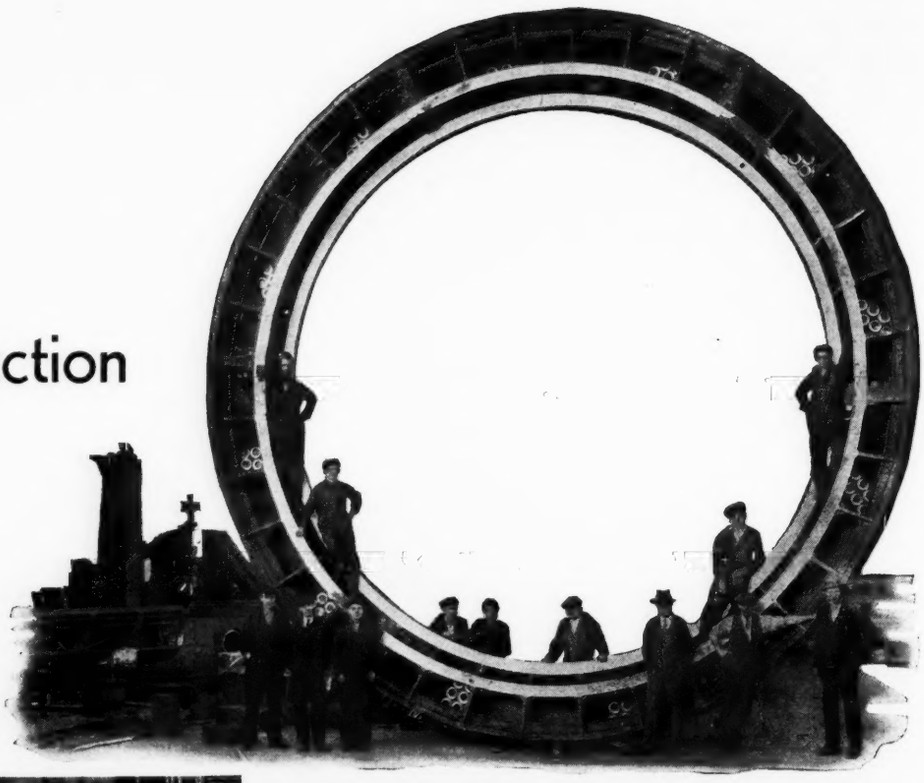
To show that the actual increase in average passenger waiting time equals the square of the deviation divided by twice the normal interval: In the first example the increase in total waiting time for the 18 passengers carried by the two cars was 36 passenger-seconds, or 2 sec. per passenger. If the deviation, which was 12 sec., is squared and divided by 72, which is twice the normal interval, the result will be $(12 \times 12) \div 72 = 2$.

In the second example the increase in total waiting time for the 18 passengers carried by the two cars was 144 sec., or 8 sec. per passenger. If the deviation, which was 24 sec., is squared and divided by 72 the result will also be $(24 \times 24) \div 72 = 8$.

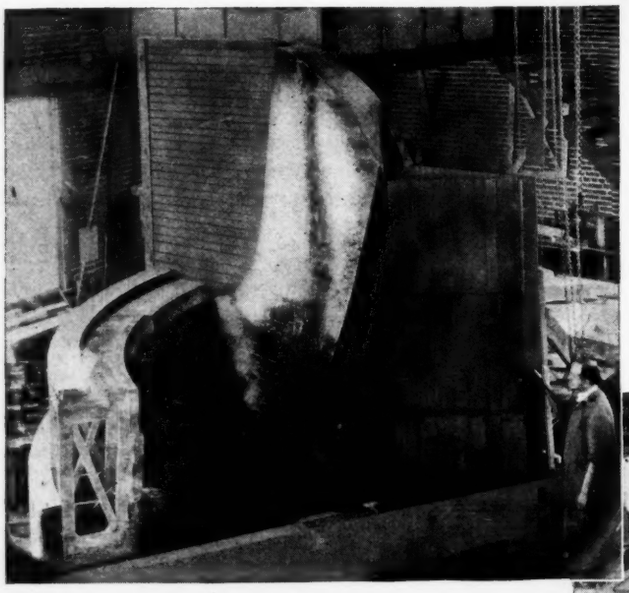
It has been assumed, in these examples, that passengers' waiting time is considerably less when constant intervals are maintained between cars than when the intervals between cars are allowed to vary; but it must not be supposed that constant intervals produce the minimum attainable passenger waiting time. If a larger number of passengers than the normal load should enter the car at the first floor before the regular time of departure, the average waiting time of those passengers in the car would be reduced if that car departed ahead of time. This early departure would also assist in the maintenance of a normal interval, because it would make possible an earlier return of this car to the first floor.

If a car should be at the top floor waiting for the normal time of departure when an abnormal number of calls were waiting to be cancelled on the down trip, a reduction in waiting time would result if this car started to descend ahead of time. The intelligent dispatcher, attentive to his job, can greatly improve the service rendered by a bank of elevators if he has at all times a complete knowledge of the position of the cars, the direction of travel of each, the location of the calls at the upper floors and the flow of traffic at the first floor.

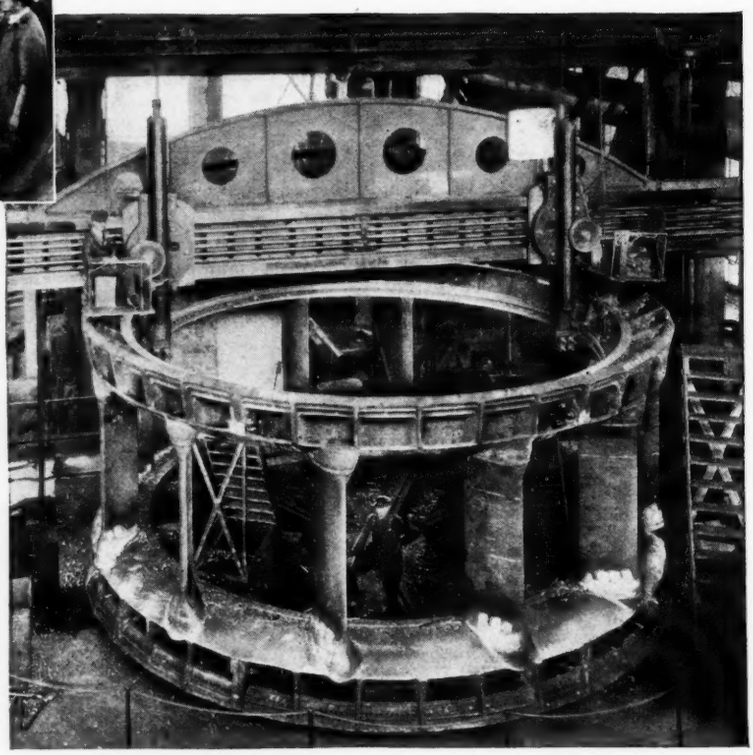
53,000-Hp. Beauharnois Turbines Under Construction



Four 53,000-hp. turbines for the generating units in the initial development of the Beauharnois Power Corporation, on the St. Lawrence River, Beauharnois, Que., are being built by the Dominion Engineering Works, Ltd. Above is shown the upper section of one of the speed rings, which are 27 ft. in diameter. Two of these rings, together with twelve cast-steel vanes, comprise a speed ring, one of which is shown below. The assembly weighs 135,000 lb. and is 12 ft. high.



Above—The corebox for one of the cast-steel francis runners. The runner throat diameter is 17 ft. 8 in.



Right—Speed ring in 35 ft. boring mill. Electric welding was used extensively in the assembly of this part of the turbine. Some of the welds may be seen in the picture, where the vanes meet the rings. The welds were so designed that all welding could be conveniently done in a horizontal position.

A New Source of Power From the Sea?

A few months ago M. C. Raveau, French scientist, proposed using the difference in vapor tension of fresh and salt water to generate power at the mouths of rivers. Mr. Knoy points out the difficulties

By M. F. KNOY

CERTAIN individuals, well-grounded in the sciences and possessed of an active imagination, are continually analyzing the sources of unused energy in the world and searching the realms of chemistry, physics and mechanics for some means of putting this energy to work.

To some one of this group is due credit for the scheme to harness the tides by arranging to store immense quantities of water at high tide and run it out through hydraulic turbines at low tide. This will likely prove a valuable source of power in certain specially favored locations, but the need is felt for some scheme of more universal application.

Recently the scientific world has been greatly interested in the plan of George Claude, eminent French scientist, to utilize the temperature difference between the surface and the depths of tropical seas for power generation. While this scheme could not be applied at every point in the world, there are numerous locations fairly close to industrialized regions where the plan might be put to work.

Of course there are certain practical difficulties that might limit or delay its wide application, but it has already been applied on a laboratory basis and thus shown to be feasible. Further development of the idea on a commercial scale is awaited with interest.

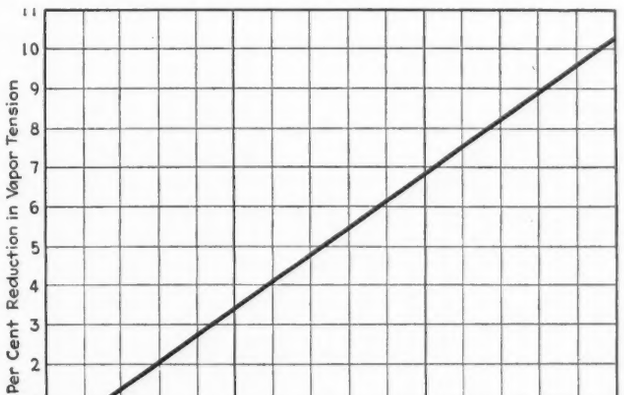
The Raveau Scheme of Power Generation

And now comes the latest scheme for obtaining power from the sea. M. C. Raveau, another learned Frenchman, proposes to make practical use of the difference between the vapor tension of sea water and that of fresh water of the same temperature. Since his plan depends primarily upon the difference in salinity between two sources of water supply it would theoretically be applicable anywhere that a river empties into the sea. Thus, from the standpoint of geographical distribution, it would have an advantage over the tide power plan as well as the thermal plan of M. Claude. However, on a strictly chemical and physical basis, the plan is weak, and a brief examination of the idea from this standpoint should be of interest.

According to Raolt's Law, any salt solution will reduce the tension of water vapor in the overlying space, and the reduction will be proportional to the amount of salt per unit volume of the solution. The accompanying curve shows graphically the magnitude of this reduction in solutions of common salt (sodium chloride).

The strength of the solution is read at the bottom in term of grammolecules of salt per liter of water. Reduction in vapor tension is read at the left in terms of percentage reduction below the vapor tension of pure water at the temperature in question. Data for this curve are taken from the table on page 512 of "The Handbook of Chemistry and Physics," tenth edition, by Hodgman and Lange.

Authorities claim that sea water carries about 3.33 per cent of solids by weight, or approximately 3.44 parts of salt per 100 parts of water. In the c.g.s. system this



Effect of salt concentration on vapor tension

would be 34.4 grams salt per liter of water. Since this salt consists chiefly of sodium chloride and since the other salts present have a similar effect on vapor tension we may, for the purpose of this discussion, consider sea water as having 34.4 grams of sodium chloride per liter of water.

Sodium chloride has a molecular weight of 58.45, and a grammolecule would therefore be 58.45 grams. Sea water thus contains $34.4 \div 58.45 = 0.59$ grammolecules of salt per liter of water. Referring to the chart, we see that this concentration would reduce vapor tension 1.9 per cent.

Assuming both salt and fresh water to have a temperature of 85 deg. F., the fresh water would have a

vapor pressure of 0.596 lb. per square inch absolute and the sea water a vapor pressure of 0.596 × 0.981, or 0.585 lb. The drop in pressure between the two surfaces would be only 0.011 pounds.

From the Mollier chart we find that this pressure drop would equal the performance of only about 1.44 B.t.u. of work per pound of steam handled.

At such a low pressure the volume would be tremendous, and it is doubtful if blade efficiencies in the turbine would be more than 50 per cent. We could thus expect only about 0.72 B.t.u. net work per pound of steam passed, which would require the handling of 3,413 ÷ 0.72 = 4,740 lb. of steam per kilowatt-hour generated.

Moreover, tremendous quantities of both the fresh and salt water would have to be handled, for the loss of vapor would tend to cool the fresh water and its absorption would tend to warm the salt water. If the fresh water ever got as much as one-half degree F. warmer than the sea water the vapor tension of the two would be equalized. The scheme is therefore equivalent to operating M. Claude's apparatus on a temperature differential of only one-half degree.

100,000 Tons of Water Per Kilowatt-Hour

If operation is to go foreward, therefore, the two waters must be kept from too great a temperature change. We assume then that a drop of $\frac{1}{20}$ deg. F. in the fresh water and an equal rise in the sea water will be permissible. Since the latent heat of vaporization at this temperature is 1,045 B.t.u. per pound, it would take 1,045 × 20 = 20,900 lb. of fresh water to generate one pound of steam with a temperature drop of $\frac{1}{20}$ deg. and approximately an equal quantity of sea water to absorb this vapor with an equal temperature rise. This would call for the handling of 20,900 × 4,740 = 99,000,000 lb. of each sort of water per kilowatt-hour generated.

If we consider the additional fact that these enormous quantities of water would have to be introduced into boiler and condenser, respectively, and then disposed of after use, we see that the idea is preposterous. Since rapid action in the condenser would be essential, it would doubtless be necessary to spray the sea water into that vessel to get the required surface area. It is plain, therefore, that we would not hope to get enough power by this plan to handle the quantities of water involved.

Other Practical Difficulties

Other difficulties in the way would be the construction of boilers and condensers, as well as turbines, of sufficient size and strength to handle the quantities of fluids involved and yet be strong enough to withstand the high vacuum. And even a little air in the sea water in excess of that in the fresh water would supply sufficient partial pressure in the condenser to stop the flow of vapor from the boiler.

Someone suggests that where the river water is warmer than the sea water this temperature difference could also be utilized to produce a greater difference in vapor pressure. This is quite true. But since we have found that when the two waters are at the same temperature no power is economically available, we might as well abandon this part of the idea, for if we fall back on a temperature difference to get sufficient vapor pressure to operate on we are merely stealing the thermal scheme of M. Claude.

Like a Hydro Plant for One-Inch Head

Just one consideration is sufficient to eliminate the scheme of M. Raveau, and that is the fact that the pressure difference due to the chemical properties of sea water is only equal to that due to a temperature difference of ½ deg. F. on the basis of 85-deg. water. One could not consider building a plant to utilize such a feeble source of energy any more than he could consider the construction of a hydro-electric plant to utilize a fall of one inch.

Though the failure of any particular suggestion to be applicable to the problem in hand should not discourage continued study of the subject, it nevertheless indicates the need for thorough engineering analysis of any new power scheme before spending too much time or money on it.

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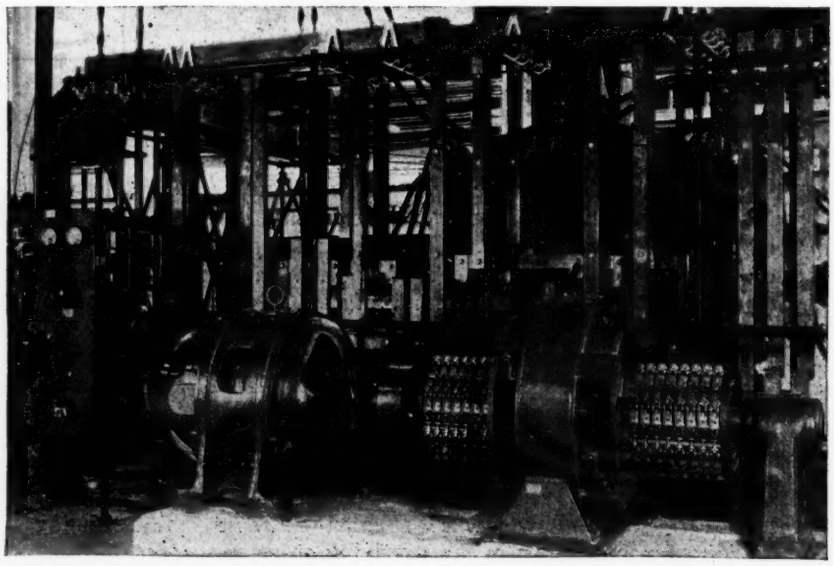


LOW-VOLTAGE heavy-current generator and busbar connections used by the Westinghouse Electric & Manufacturing Company for testing circuit breakers. The current is supplied by a double-commutator direct-current generator, rated at 6,000 amperes and 6 volts, driven by an induction motor.

Centrifugal Pumps Operated Under Abnormal Conditions

THE RESULTS of tests made to determine the effects of water-hammer in the discharge line of a centrifugal pump when it is suddenly stopped, by cutting off the power or by the rotor's being fouled by an obstruction

By C. P. KITTREDGE*
With Dr. D. Thoma
Munich, Germany

CENTRIFUGAL PUMPS may be subject to sudden shutdowns while operating under normal conditions. If not adequately protected by screens, the impeller may become jammed by foreign material present in the water. On electrically driven pumps they may occur because of failure of the current supply. One of the objections to sudden shutdowns is that water-hammer may occur in the discharge pipe, especially if the pipe is long and the head relatively low. This has generally been attributed to the delayed closure of non-return valves installed in the pipe, but the phenomenon also occurs in pipes where no valves of this nature are present. Water hammer will occur if such a valve is slow in closing, but the valve is not necessarily the cause of it.

According to the views of Dr. Thoma[1], the probable events taking place after an interruption of the power supply are: The impeller slows down rapidly because of the rotating part's low inertia, but the water column in the discharge pipe continues in motion, due to its greater intertia, and will possibly draw water through the pump. The slowly rotating, or perhaps stationary, impeller offers a high resistance to water drawn through it, so that under extreme conditions the water column breaks, forming a vacuum on the pressure side of the pump. When the water column comes to rest it will recoil causing water-hammer, with possible injury to the pump and pipe.

There are, in addition, other sources of trouble: Following the recoil, the water in the discharge pipe will flow back through the pump and out the suction pipe, and this reverse flow may continue until a valve can be closed or the motor started again. The flow being reversed, the pump runs as a turbine at a speed equal to runaway, which may be considerably higher than its normal value. If power is applied before the reverse flow has been stopped, the impeller will assume its original direction of rotation. The water, however, due to its inertia, will continue in reverse motion until sufficient pressure has been built up to change the flow to its original direction. Any, or all, of these events may produce undesirable conditions in the pump, with possibility of serious damage from water-hammer or from high centrifugal stresses in the motor.

If it is desired to compute the magnitude of these effects for design purposes or for locating the source of trouble, we may consider that the form of flow for a given pump depends only on the value of the ratio $\frac{Q}{N}$ where Q equals the discharge per unit time and N equals the pump's speed in revolutions per minute. If the unimportant effect of viscosity is neglected and it is considered that no cavitation takes place, we know that for a given pump the values of $\frac{H}{N^2}$, $\frac{P}{N^3}$ and E depend only on $\frac{Q}{N}$, where H equals the total head, P equals the power input to the pump shaft and E equals the efficiency. We may consider that the hydraulic ratio $\frac{Q}{N}$ for normal operating conditions is $\frac{Q\ normal}{N\ normal}$, which is generally the value for maximum efficiency. This ratio will be designated by $\frac{Q_n}{N_n}$.

During the time interval immediately following the failure of the power, the pump's speed will, in many cases, decrease much more rapidly than the discharge

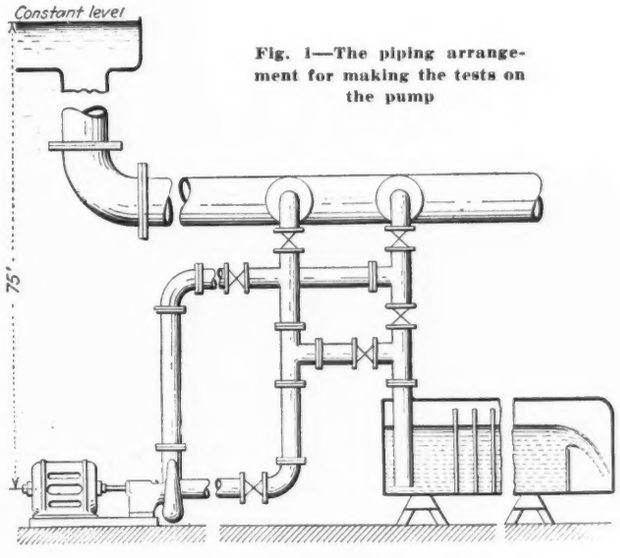


Fig. 1—The piping arrangement for making the tests on the pump

*Graduate of the Massachusetts Institute of Technology and holder of one of the John R. Freeman Fellowships.

[1]Professor of hydraulics and director of the Hydraulic Institute of the Technical University of Munich, Germany.

flow, which means that the hydraulic ratio will increase, varying widely from the normal $\frac{Q_n}{N_n}$ value. This hydraulic ratio can no longer be determined from the customary $Q - H$ characteristics for the pump running at constant speed, because, as far as known to the writer, these have never been measured outside of the range from $Q = 0$ to $H = 0$.

A series of tests are being carried out by the writer under the direction of Dr. Thoma to obtain some of the necessary data on the behavior of pumps under abnormal conditions. The following tests were made with a small centrifugal pump driven by a direct-current motor. A reversing switch in the field circuit of the motor permitted rotation of the impeller in either direction, as desired. The speed was adjusted by a variable resistance in the armature circuit. Water was supplied from the laboratory's constant-head tank with a maximum available head of about 75 ft. The piping arrangement, Fig. 1, was such that the water could be drawn by or forced through the pump in either direction, as desired, and discharged over a sharp-crested suppressed weir. The discharge was computed by the Rehbock formula.

Studies were made with the values of Q_n and N_n for practically the best hydraulic efficiency as determined by preliminary tests. Flow through the pump from the suction pipe to the discharge pipe will be considered positive discharge and flow in the reverse direction negative discharge. Rotation in the usual direction will be considered positive rotation and in the reverse direction negative rotation. The tests have been arranged in the following order:

Test No.	*Constant*	*Variable*
1	$N = +N_n$	Q from $-Q_n$ to $+Q_n$
2	$Q = +Q_n$	N from $+N_n$ to $-N_n$
3	$N = -N_n$	Q from $+Q_n$ to $-Q_n$
4	$Q = -Q_n$	N from $-N_n$ to $+N_n$

The normal conditions of operation were $Q_n = 145.5$ g.p.m. and $N_n = 1{,}060$ r.p.m., the latter being very much

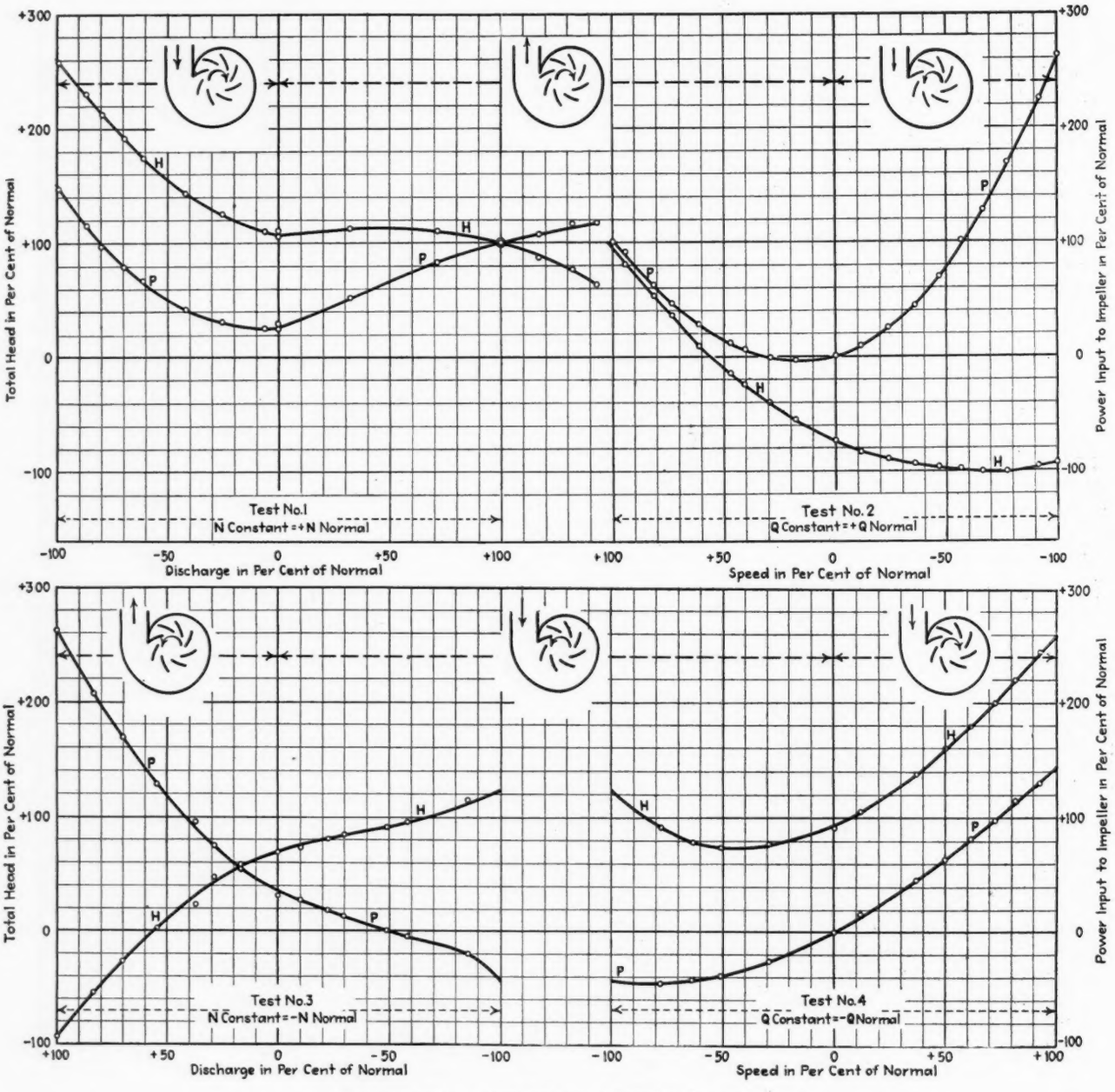


Fig. 2—Results of tests made to determine the performance of centrifugal pumps under abnormal conditions

lower than the speed necessary to cause cavitation under the existing conditions. The other corresponding normal values were $H_n = 13.80$ ft., $E_n = 68.7$ per cent and the net power input to the impeller 0.471 hp. The best efficiency was later found to be 69 per cent at a discharge of 143 g.p.m., so that the normal conditions may be considered those of maximum efficiency for all practical purposes. The results are shown in the accompanying curves, Fig. 2.

Curves H show the head-discharge characteristics for constant speed and the head-speed characteristics for constant discharge. Curves P show the power-discharge characteristics for constant speed and the power-speed characteristics for constant discharge. The bearing friction in a small pump uses up a large part of the driving power, so that it was necessary to eliminate it from the power curves. These latter curves were therefore constructed by computing the power input to the pump shaft and subtracting from it the power necessary to turn the impeller in air for the speed in question. Consequently, efficiencies computed from values of Q, H and P taken from the curves will be hydraulic efficiencies.

Curves for the right-hand half of test No. 1 show the familiar Q — H characteristic. The normal discharge was maintained constant during Test No. 2 and the speed was reduced to zero, at which point the ratio $\frac{Q}{N}$ equals infinity. It should be noticed that the head at this point is negative and amounts to about 75 per cent of H_n. The maximum negative head is shown by the right-hand portion of the curve, for negative speeds, and is practically equal to H_n. The speed was maintained constant at minus N_n during Test No. 3 and the discharge decreased to zero. Water was then forced through the pump in the reverse direction until minus Q_n was reached. The power curve crosses to zero axis at 51 per cent of Q_n, the head being 91.5 per cent of H_n. This makes the runaway speed under normal head (13.80 ft.), $1{,}060 \div \sqrt{0.915} = 1{,}110$ r.p.m., or 4.71 per cent above normal speed. The low efficiency of the pump was responsible for this low value of the runaway speed. Highly efficient pumps may show 30 or 40 per cent increase in the runaway speed over normal speed. Beyond the point on the curves just mentioned, the pump was running as a turbine and the speed was held constant by allowing the motor to run as a generator, the load being the variable resistance in the armature circuit.

Conditions in Test No. 4 were the reverse of those in Test No. 2. The maximum positive head, about 258 per cent of H_n, occurs at the point at which plus N_n and minus Q_n were reached. The normal speed was maintained constant for the left-hand half of Test No. 1 and the discharge increased to zero, thus completing the circuit of the abnormal running conditions.

The following example shows the method of investigating the conditions in a pump system following a failure of the power supply. The data on the installation, Fig. 3, is: Total head, 80 ft.; suction head, 14 ft.; discharge, Q_n, 4.20 cu.ft. per second; length of discharge pipe, 5,000 ft.; diameter of discharge pipe, 12 in. The pump is driven at 1,100 r.p.m. by a directly connected electric motor.

It will be assumed that the pump has characteristics corresponding to the curves in the tests and that the inertia of the rotating parts is negligible in comparison with the inertia of the water column in the discharge pipe. Following a failure of the power supply the speed will decrease almost instantly to the point at which the braking torque of the water is zero. Due to the fact that the speed is reduced almost instantly, the water column in the discharge pipe has not yet retarded appreciably, so that immediately following the failure of the power the flow is almost equal to normal. This shows that the curves in Test No. 2 for normal flow will be applicable to the conditions in the system after the shutdown.

The speed will fall to the point at which the power curve crosses the $P = O$ axis. The resistance offered by the pump to flow through it is shown by the head curve to be 39 per cent of H_n and is therefore $80 \times 0.39 = 31.2$ ft. of water. In addition to this, the suction head and the pressure head up to the centerline of the discharge pipe, Fig. 3, must be overcome, making a total of 46.7 ft. of water to be supplied by the atmosphere if the water column in the discharge pipe is to remain intact. This is impossible, because the atmosphere will only support about 34 ft. of water; therefore the column will break, forming a region of almost perfect vacuum in the discharge pipe.

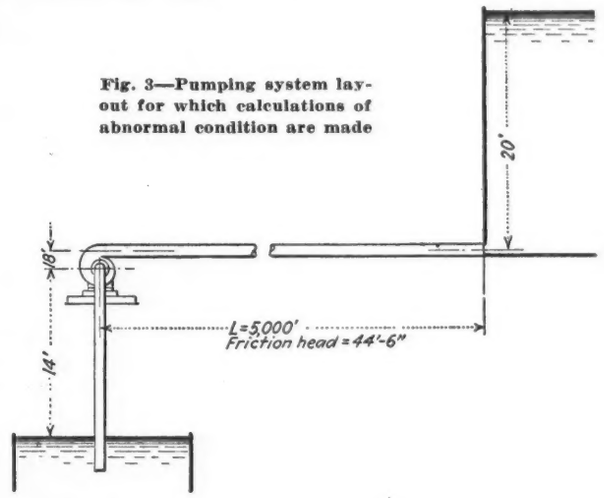


Fig. 3—Pumping system layout for which calculations of abnormal condition are made

All this will take place only if the previous assumptions were correct. To check these assumptions we may proceed as follows:

Let, L = Length of discharge pipe.
A = Area of discharge pipe.
Q = Normal discharge.
g = Acceleration of gravity.
h = Retarding head on water column following the shutdown.

The retarding head h is the total head minus the head furnished by the pump. The head furnished by the pump h_p may be obtained by a step-by-step process of computation starting with the normal conditions and working down the curves until the power curve crosses the $P = O$ axis. Neglecting h_p in computing the slowing down of the water column results in too high a rate in the first time interval when h_p has an appreciable positive value and in too low a rate at a later time when h_p may be negative and consequently increase the retarding head.

Assuming the retarding head h as equal to the total head, the time necessary to bring the water column to a stop following the shut-down will be:

$$T = (Q \times L) \div (A \times g \times h)$$
$$= (4.20 \times 5{,}000) \div (0.785 \times 32.2 \times 80)$$
$$= 10.4 \text{ seconds.}$$

Therefore the initial rate of slowing down of the water

column in the discharge pipe is:

$$\frac{1}{T} = \frac{1}{10.4} = 0.096 = 9.6 \text{ per cent per second.}$$

To compute the rate of slowing down of the pump,
Let, P = Driving power in horsepower.
E = Motor efficiency = 75 per cent.
w = Weight of water = 62.4 lb. per cu. ft.
W = Weight of rotor.
r = Effective radius of weight of rotor.
ω = Angular velocity in radians per second.
M = Normal torque of motor.
h = Total head of pump in feet.
The power required by the pump is:

$$P = (Q \times w \times H) \div (550 \times E)$$
$$= (4.20 \times 62.2 \times 80) \div (550 \times 0.75)$$
$$= 50.8 \text{ horsepower.}$$

The angular velocity corresponding to 1,100 r.p.m. is 115 radians per second. The normal torque is, therefore, $M = (50.8 \times 550) \div 115 = 243$ foot-pounds.

The inertia of the rotor of a motor of this size is about $(W \times r^2) = 85$ lb-ft.^{2}, therefore the initial rate of slowing down of the pump is:

$$R = (M \times g) \div (W \times r^2 \times \omega)$$
$$= (243 \times 32.2) \div (85 \times 115)$$
$$= 0.80 = 80 \text{ per cent per second.}$$

This rate of slowing down is so high compared to that of the rate of slowing down of the water column that the effect of the inertia of the pump impeller may be neglected. The water column in the discharge pipe will break, forming a vacuum region as previously computed.

If, instead of the power supply failing, the impeller should become jammed by foreign material present in the water, it would be brought to a stop almost instantly. The conditions would then be much worse than in the preceding example, because the resistance offered by the pump would be $0.746 \times 80 = 59.7$ feet of water, so that even if the suction head were zero the column would break and a region of vacuum would be formed much sooner than before.

▼ ▼ ▼

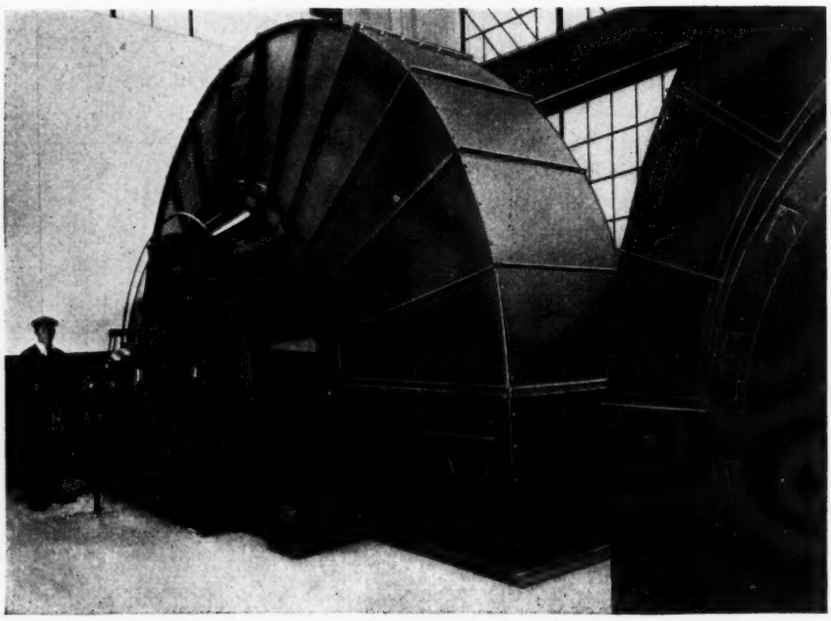
Largest 25-Cycle Synchronous Converters

At the Roessler & Hasslacher Chemical Company, Inc., Niagara Falls, N. Y., there have been installed two 5,440-kw., 167-r.p.m. Westinghouse synchronous converters, the largest 25-cycle converters ever built. One of the unique features of the machines is the volute type of ventilating inclosure, shown in the picture. This method of ventilation utilizes the fan action of the rotor to force the heated air from the machines and discharge it outside the substation. The effectiveness of the inclosure was demonstrated by test results obtained after installation. They showed that at loads of 6,000 kw., 10 per cent overload, the copper temperature did not exceed 50 deg. C. rise and other parts were below 35 deg. rise. The efficiency of the machines at full load is 95.5 per cent.

The direct-current voltage is adjustable in sixteen steps by full-load tap-changing equipment mounted on the side of the outdoor transformers, The machines are self-started by star-delta transformer connections, the breakers for which are in a compartment on the side of the transformers.

Erection of these converters was in itself an outstanding feat. Around and above an existing converter substation, which could not be shut down, a new steel-frame building was erected. The new converters and equipment were placed on the floor above the old machines, and were made ready to run without interruption to service.

The performance of the machines since their installation has already exceeded expectations. During the acceptance tests one of the machines was suddenly called upon to handle an overload in excess of 150 per cent. It was carried without any sign of machine distress or commutation impairment. This liberality in commutating performance is obtained by a new flexible type of commutator construction and the use of double brushes.



Two 5,400-kw. synchronous converters have volute type of ventilation inclosure

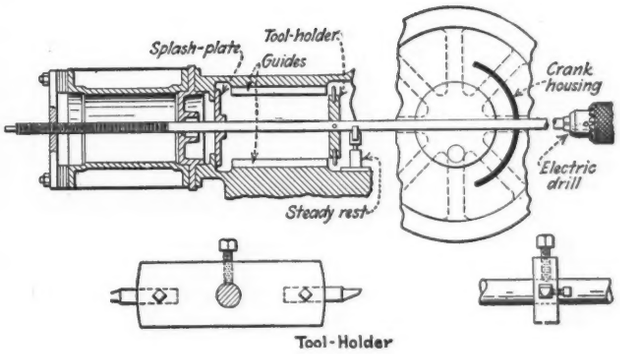
. . . RIGHT OUT OF THE PLANT . . .

Reboring Crosshead Guides of High-Speed Engine

RECENTLY mechanics in Packard Laboratory at Lehigh University were confronted with a problem in repair work which was solved in a rather unusual manner. The job consisted of reboring the crosshead guides and relining the crosshead on an old Ball engine. Even if the crosshead had been equipped with some kind of an adjustment, it would have been necessary to rebore the guides, for they were slightly barrel-shaped, being $\frac{1}{32}$ in. farther apart in the center than at the ends. It would have been too costly to purchase a boring machine for only one job, and to have taken the engine apart to send it to a machine shop would have entailed considerable expense and time. The problem was solved in the following manner:

The splash plate was rebored a few thousandths larger to give a running fit for a piece of lineshafting 3 ft. longer than the over-all length of the engine. Then the shaft was threaded, 32 threads per inch for about 3 ft., on one end. Another running fit was made by boring a hole in the far end of the crankhousing. This hole was in line with the hole in the splash plate and the axis of the crankshaft bearings. A piece of $\frac{3}{4}$-in. bar stock long enough to be bolted on to the head end of the cylinder was machined to fit the threads on the shaft. This piece, when bolted to the cylinder, served as a means of propelling the shaft back and forth within the machine. A steady-rest from a small grinding machine was bolted to the inside of the crankhousing just beyond the guides and on the side opposite the splash plate. We now had a rigid shaft revolving about and traveling along the true center of the guides.

A tool holder, as shown in the detail, was then clamped on the shaft and a standard portable electric drill was used to turn the shaft. By attaching the drill first on one end and then on the other the boring tools were moved back and forth and the guides were machined to a perfect circle about the proper centers. Polishing was accomplished by screwing a lapping block to the tool holder, emery cloth and a regular grinding compound producing a satisfactory finish.



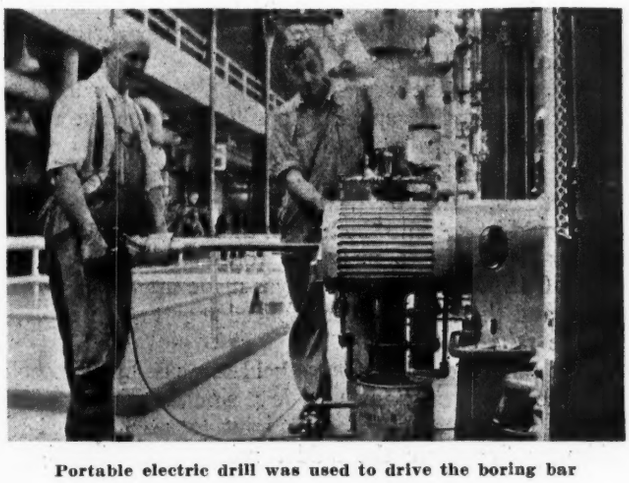
Section through engine showing how boring bar was supported

The remainder of the job was fairly easy. The crosshead was turned down about $\frac{1}{8}$ in., and $\frac{3}{8}$-in. brass plates were bent and machined to fit. After the plates had been screwed on they were turned down on the outer surface to give the proper running clearance.

The machine was soon back in use and it performed most satisfactorily.

R. N. YOUNGBLOOD,
Department of Mech. Eng.,
Lehigh University.

Bethlehem, Pa.



Portable electric drill was used to drive the boring bar

Welding of Leaky Joints

IN THE MARCH 31 NUMBER Charles W. Carter, Jr., comments on the answers to a question about the value of arc-welding of boiler joints to obtain tightness, the answers appearing in the Feb. 24 number. He does not think the discussions added materially to the information on the subject.

Mr. Carter doubts that riveted joints have an initial slip when subjected to load. Numerous tests, however, have demonstrated conclusively that there is slip. When driven, the red-hot rivet fills the hole completely. With cooling, shrinkage and a drawing away from the walls of the hole occur. The plates are now held only by friction. When pressure is raised, as when the hydro-

static test is applied, the joints tend to slip until the rivets take the load directly by shearing resistance. Slip depends upon a number of factors, tests of the resistance to slip naturally showing extreme variations in results. Later, under the combined effects of operating pressure and temperature, the joint is again disturbed.

It should be borne in mind that the amount of slip necessary to place a large stress in a calk-weld is not necessarily visible to the naked eye, a stretch of 0.001 in. per inch of length imposing a stress that approaches the yield point.

In visualizing the behavior of a combination such as a riveted joint with welded edges one should consider the subject from the point of elasticity. A joint may be strong enough and yet have the weld fail because, due to its position, it takes the entire load.

Mr. Carter perpetuates the term "crystallization" in connection with the failure of steel. That term is a favorite with the garage mechanic when he explains the cause of the fracture of the rear axle.

Los Angeles, Calif. C. O. SANDSTROM.

Damper Control Proportions Air for Oil Furnace

OIL is being more generally employed as fuel in industrial boiler plants, and frequently operating difficulties appear, which may be corrected quickly if the underlying cause is appreciated.

An oil pump and fan driven by a constant-speed motor was used at the plant where I was employed, the burners being air atomizing. The oil pressure to the burners was controlled by a pressure-regulating valve actuated by the boiler steam pressure. The air for atomization or primary air was supplied by the fan, while the secondary air was drawn in through checkerwork under the burners and back to the bridge wall as is the usual practice.

The trouble with this system was that when the steam pressure went up, automatically cutting down on the oil supply, the air flow remained constant. This resulted in a high percentage of excess air every time the load on the boiler dropped. A cooling of the furnace walls followed as well as a big drop in CO_2.

A definite quantity of oil was burned in bringing the furnace walls back to their original temperature, at which time the regulator again opened.

As do most plants changing from coal to oil equipment, our plant possessed an automatic damper regulator which had been discarded. This regulator was used to great advantage in correcting the condition mentioned. The diaphragm was removed and replaced with a copper one. The regulator was then connected to be under control of oil pressure instead of steam. It was then connected to the uptake damper in the reverse of its former method, that is, when the oil pressure dropped the damper closed. A stop was provided so it could not close beyond a point that would cause a positive furnace pressure. It was connected to the oil line instead of steam so in case of any accidental opening of the oil-regulator valve, there would be no danger of a flare back.

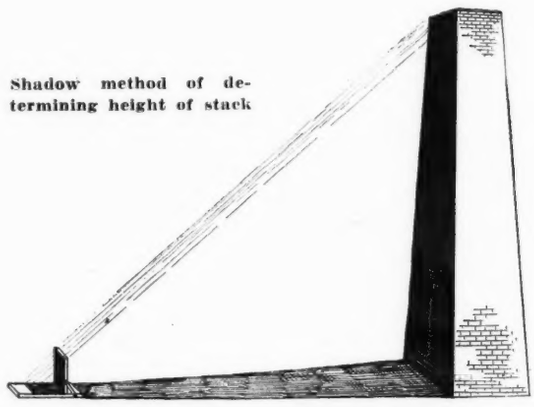
This arrangement proved very satisfactory in the control of air flow. H. M. SPRING.

Milford, N. J.

Repairing a Square Brick Stack

AN "OLD TIME" square brick stack about 140 ft. high vertical cracks developed on three sides of the structure, commencing about 20 ft. above ground and extending upward about 20 ft. It was decided to reinforce the stack along the entire cracked portion by placing structural-steel shapes at each of the four corners and then tying the corner shapes together with one-inch rods spaced vertically 12 in. apart.

Each corner shape consisted of a Z-bar with heavy flanges, to one of which there was bolted a heavy 4-in. angle. The Z-bars were each 10 ft. long, and two were used at each corner. The 4-in. angles were cut in lengths of 5 and 10 ft., two of the shorter and one of the longer pieces being used on each corner. It was decided to scale the chimney from the inside. Accordingly, enough ladders, 17 in. wide, were made up to reach from the bottom to the top of the chimney.



Shadow method of determining height of stack

The height of the chimney was first determined by means of the shadow method. A right angle was made up from two pieces of board, with the horizontal piece marked at a point away from the vertical board a distance equal to the height of the vertical piece. The boards were placed adjacent to the chimney the height of which was to be determined. The bottom board was accurately leveled and moved as necessary to keep it pointing toward the sun. Close watch was kept of the shadow cast by the top of the vertical board, and when that shadow exactly touched the pencil mark on the horizontal board a stake was driven into the ground at the farthest point reached by the shadow of the tall brick chimney. Measurements made from the stake to the base of the chimney showed the distance to be 138 feet. It was assumed that the base of the chimney projected at least two feet, therefore the chimney height was assumed to be 140 feet.

To facilitate the work of placing the reinforcing bars it was decided to suspend a rope tackle from the top of the chimney. To reach the top of the chimney a sectional wooden ladder 140 ft. long and 18 in. wide was constructed. As 10 ft. was the longest ladder-section that could be got into the hole in the base of the chimney, it was necessary to make up fourteen ladder-sections, each 10 ft. long. The ladder was made of 2x4-in. spruce rails, and the sections were spliced together with pieces of the rails 3 ft. long.

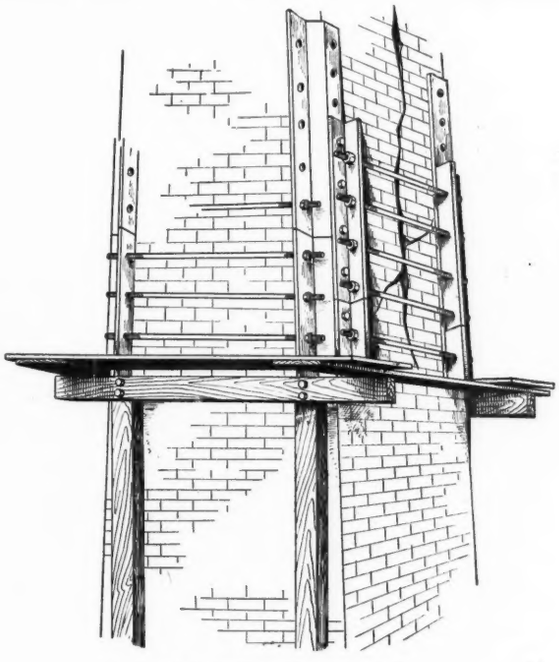
The rail splice-blocks were held in place by ½-in. bolts and the rungs were fastened in a similar manner. Two braces were attached at each joint to reach across the chimney flue from the ladder rails and wedge tightly

against the opposite side. The bolt holes for the splicing rails were drilled from a template so that two or more sections could be bolted together to give a ladder of a suitable length for other work.

A staging was first erected in the chimney to which a rope tackle could be attached for hoisting the ladder and from which the sections could be bolted together. As each section was bolted in place the completed ladder was hoisted by the tackle and another section placed under it. In this manner the scaling ladder was built up to the top of the chimney.

Some wire cable was obtained and a loop formed on one end into which one block of the rope tackle could be hooked. As the erector made his way to the top of the ladder, stopping at each joint to swing the braces into position and tighten them in place, he carried one end of the cable along with him. Upon reaching the top of the chimney he lowered the wire rope loop to the ground, outside of the chimney, and the rope tackle was hooked into the ring and tied securely to prevent its unhooking while being hoisted into place. The rope tackle was hauled up to a height sufficient for hoisting the material for reinforcing the chimney. Then the cable slack was hauled down and made fast to a timber placed across the smoke entrance to the chimney. The staging on the outside of the chimney was built up of 6x6-in. timbers and 12-in. planks, as shown in the illustration.

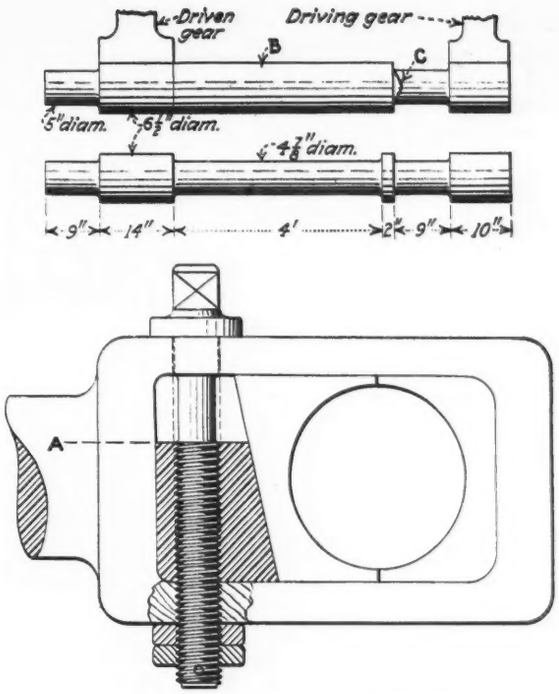
When the first 5-ft. sections of the reinforcing had been put in place and tightened up another staging was attached directly to the upper row of rods on three sides



How stack was reinfroced

of the chimney. It was evident that three more stages would be required, and accordingly 18 wall brackets were obtained. Six of these brackets were used for each staging, two on each side of the chimney. For these, a threaded bolt was cut off under the head and forged into a hook which was caught over a rod; then the nut was screwed up until the bracket was clamped tightly.

Planks were placed upon these brackets, and from them the workmen put in place the upper set of Z-bars. After all the rods had been placed they were tightened progressively, being gone over many times and screwed up tight. Then the cracks were filled with cement mortar and the job was complete.



Changes in design of shaft and adjusting screw obviate breakage

Minimizing Breakdowns Through Better Design of Parts

THE ILLUSTRATION shows a shaft which has too much material at a particular part, and the same shaft redesigned for durability and reduction in weight. Previously to the reduction in diameter of the central part of the shaft *B* the shaft fractured several times at *C* and had to be replaced. Since the alteration it has not given any trouble.

Similar changes could be made to advantage in the design of adjusting screws of crossheads and connecting rods of large steam engines. The illustration shows a good design. When the bolt was left full size, as indicated by the dotted lines, it would break at the point *A* at the end of the threads. J. T. TOWLSON.

London, England.

Specific Heat of Diphenyl-Oxide

IN AN EDITORIAL in the May 5 issue of *Power* reference is made to the use of diphenyl-oxide, and it is stated that the specific heat of this material is 3.78 times that of water. I presume this is taken from a bulletin on diphenyl-oxide, prepared by the Dow Chemical Company, a copy of which is before me.

In that bulletin the ratio is based on the specific heat of the liquid per *gram molecule* in calories at 100 deg. C. The ratio given is likely to be misleading; I believe the specific heat of diphenyl-oxide, usually referred to as being the amount of heat required to raise 1 pound 1 deg. F., is about 0.4, varying with the temperature. On this basis water actually has a specific heat of about two and one-half times that of diphenyl-oxide.

Boston, Mass. J. W. F. MACDONALD.

[Mr. Macdonald is correct. Under "specific heat of liquid" the table gives "ratio to water" as 3.78, but it was not noticed that this was per gram molecule.—EDITOR.]

From Among Readers' Problems

Conducted by
L. H. MORRISON

REVERSING A DOUBLE-LEATHER BELT—*We have a double-leather belt operating a fleshing machine under wet conditions, which at the peak of the load is inclined to slip. In fact it has slipped at times, even when treated with a belt-slip material. This belt has been in continual service for nine years, and, to my knowledge, has never been reversed. The question is this: Should a double-leather belt be reversed and how often? By reversing I mean placing the outside of the belt on the inside, where contact is made with the pulley, but not changing the direction of the joint laps.* P.J.C.

The belt may be slipping from overload or from being too wet. It does not pay to use a sticky belt dressing to correct the trouble. The proper step is to remove the belt and submerge it in a tank of gasoline until all the dirt and oil have been removed. After being dried the belt should be given a thorough treatment of belt dressing obtained from or recommended by the belt makers. There is no advantage in reversing the belt.

REMOVING PISTON OF CORLISS ENGINE—*Please outline, step by step, the process of removing the piston of a corliss engine.* C.W.P.

It is usual to remove the piston and rod intact, separating the two after they are out on the floor. The rod may be held in the crosshead by either a screw thread and locknut or by a gib key driven into a slot in the piston rod and crosshead.

In either, the first step is to remove the cylinder head, and the head end valves if the latter project into the cylinder counterbore. The piston rod is then loosened from the crosshead. If, after the gib key is removed, the rod is tight in the crosshead, it may be loosened by uncoupling the connecting rod, so that the crosshead is free, and sledging the crosshead with a lead mallet and sledge. The inertia of the piston and rod is enough to cause them to resist movement at the time of the blow. No real difficulty should be experienced. If the rod still sticks, an offset gib may be made so that instead of the rod's being tightened it will be loosened when the gib is driven home. Screw-end piston rods are removed easily by loosening the locknut and unscrewing the rod. A copper sheet should be inserted between the rod and pipe tongs to prevent scarring the rod.

With the piston rod loose from the crosshead the piston is shoved to the open cylinder end. To prevent the rings' dropping into the exhaust valve opening, metal strips should be laid in the counterbore.

With a heavy piston, a crane is necessary, although the piston and rod can be slipped out upon a plank cribbing.

A Question for Our Readers

IS THERE any advantage in adding water to lubricating oil from diesel crankcases before it is passed through a centrifuge? Is the water temperature of any moment? J.F.

Suitable answers from readers will be paid for and published in the July 7 number

PREVIOUS QUESTIONS DISCUSSED BY READERS

1. *WE HAVE 135 lb. steam pressure, which we use to heat a solution to 340 deg. F. We wish to raise this to 375 deg. F., and someone has recommended using superheated steam direct from the boiler; our superheater gives a 400 deg. F. total temperature. But one of our engineers says superheated steam will not raise the solution temperature. Can we get a 375-deg. solution?* C.C.R.

BECAUSE of the enormous amount of superheated steam that must be used to heat the solution to 375 deg., in proportion to that required to produce a temperature of 340 deg., I believe the best method will be to heat the solution in two stages. The first stage, as at present, would be heating with steam to a temperature of 340 or 350 deg., in the second stage, by transferring the solution to some other container it would be heated to the desired final temperature by the direct application of heat, either by oil or gas burners or by an electric heating unit. The amount of fuel or current per pound of solution would be small, and no doubt would cost much less than steam at the pressure and temperature mentioned.

I believe that electric heating is preferable, because of the accurate heat control possible with its use. If the solution has the same specific heat as water, 1 kw.-hr. will heat approximately 135 lb. of solution from 350 to 375 deg. F. A. C. MCHUGH.

Norwalk, Calif.

IT WOULD BE physically possible to secure the desired degree of heat in this case, but whether it could be done economically would depend upon the layout of the plant.

At a boiler pressure of 135 lb. the saturated steam would have a temperature of approximately 358 deg. F. This would be the maximum temperature the steam would impart to the solution in an ordinary dead-ended coil, for when the coil full of steam once lost its superheat it would thereafter remain at the saturated temperature. If, however, this saturated steam is bled from the coil as rapidly as it loses its superheat the 400 deg. steam could easily raise the temperature of the solution to the required point.

The saturated steam could be vented to the feed-water heater so that the coil would receive a fresh supply of superheated steam constantly. While the solution is cold the steam will lose all of its superheat and a portion of it will give up its latent heat by condensation. Heating will thus be rapid until the temperature of 358 deg. is reached, after which no further condensation will occur and heating will be by superheat only. However, since only 17 deg. more heat will be required it should not take much additional time.

In case no additional steam can be used by the feed-water heater the plan outlined above would waste a considerable amount of steam. In this case it would perhaps be better to operate the coil unvented until a temperature of, say, 355 deg. is reached by the solution. Then the coil could be vented to the condenser, or to the atmosphere if necessary, to secure the additional heating.

Better still, it might be possible to operate the coil in parallel with the main steam header. In this case the coil would need no other venting and no waste of heat or steam would occur. In the average installation there would be sufficient pressure drop between the boiler and the engine to produce a lively rate of steam flow through the steam coil while the engine is running. The condensate could be removed from the coil by a trap and the saturated steam going on to the engine could still perform much useful work.

M. F. KNOY.

Beaumont, Texas.

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2. *WE ARE operating our turbine condenser at 29-in. vacuum. Plans are being made to install a bleeder heater to draw off turbine steam at 10-in. vacuum, and the condensate of the heater is to be discharged into the condenser hotwell. What kind of syphon seal should be used, and what is the necessary leg length?* P.R.

I BELIEVE that there is one angle to this question that may have been overlooked when it was asked. It makes the question different from one of straight difference in pressure.

The pressure in the heater is given as 10 in. vacuum, while the pressure in the condenser is given as 29 in. vacuum. The temperature of saturated steam at 10 in. vacuum is 192 deg. F. This means that the condensate from the steam in this heater is 192 deg. F. The temperature of the condensate under 29 in. vacuum is 79 deg. F. This means that the sensible heat per pound of condensate, in moving from the heater to the condenser, will be decreased 192 —79 = 113 B.t.u.

The latent heat of evaporation under the lower pressure is 1,041 B.t.u. Therefore, of the condensate $\frac{113 \times 100}{1{,}040}$ or 10.86 per cent, will be evaporated in moving from the higher pressure to the lower pressure. The specific volume of steam under the lower pressure is 656 cu.ft. per pound. Therefore, a total of 656×0.1086, or 71.2 cu.ft. of steam, will be generated for each pound of condensate which moves from the higher to the lower pressure.

There may be several types of syphon seals with which I am not familiar, but I do not think that a straight U-tube syphon, in this case, would be as satisfactory as might be expected. Under normal conditions, with water at a normally low temperature, the two pressures in the question would call for a tube sufficiently long to allow a difference in water level of slightly more than 21.5 ft.

Such a tube would probably do very well if it were not for the fact that the water on the side of the U-tube nearest the condenser will begin to boil as it moves up the tube toward lower pressure, since its temperature is above the boiling point at the lower pressure. This steam forming in the pipe would produce a geyser effect as it moved up the pipe, reducing the density of the fluid on that side of the tube to such an extent that it would require a tube of much greater length to produce the desired difference in pressure. A tube of such length would no doubt prove to be inconvenient and costly to install.

I suggest that a reliable trap be placed in this line rather than a syphon of any type. A trap for this small difference in pressure can be bought at a low cost, installed in a convenient place, and will no doubt give perfect service.

R. F. SORRELLS.

Beaumont, Texas.

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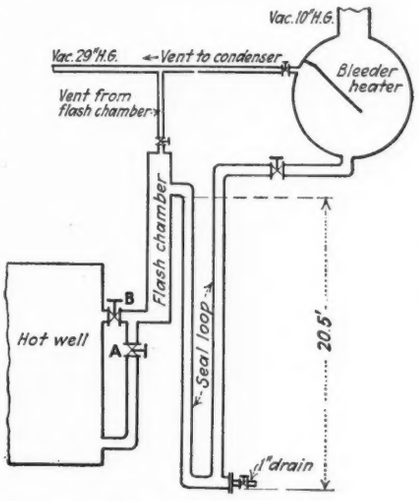
I DO NOT BELIEVE there is a more satisfactory and trouble-free type of syphon seal than the ordinary seal loop discharging into a flash chamber and then into the hotwell. The illustration, while not drawn to proportion, will more clearly convey my idea. The reason for having a high and low discharge into the hotwell is that the hotwell temperature can, within limits, be controlled by manipulating valves *A* and *B*. Valve *A* is opened to raise the temperature, and *A* closed and *B* opened to lower the temperature.

I should use the following method to determine the leg length: A vacuum of 29 in. is equal to 14.2 lb. per square inch abs., and 10 in. vacuum is equal to 14.9 lb. per square inch abs. Therefore the pressure in the heater will be 14.2 — 4.9 = 9.3 lb. greater than in the condenser pressure, or the condenser will exert a pull of 9.3 lb. on the loop. The theoretical suction lift for 9.3 lb. abs. is 9.3 × 2.3 = 21.45 ft. The velocity of the water through the loop will be about 3 ft. per sec. and the friction head at this velocity is about 1 ft., so 21.45 — 1 = 20.45 ft. is the proper leg length. It could be made less by figuring the velocity head, the loss in head due to temperature and, etc. I do not believe these losses would amount to much, possibly two or three feet, so to be safe the leg length should be 20.45 ft.

C. G. ROBINSON,
Venice, Ill. Venice Power Plant.



Syphon with flash chamber

BEFORE DISCUSSING the size and type trap to be used for draining the proposed heater, I should like to offer some suggestions as to the best place to drain the heater.

It is stated that the heater trap is to be drained into the condenser hotwell.

A hotwell, unless it is of the weir-deaërating type, is an unsatisfactory place into which to drain a heater that is operating at a higher pressure than the condenser. The condensate from the water will be at a temperature of approximately 162 deg. F., while the temperature required to flash steam in the condenser is 79 deg. F. The condensate from the water will, of course, be lower than 162 deg. F., due to radiation in the pipe line and refrigeration as the condensed steam is falling over the tubes but it will heat a sufficient temperature to flash rapidly upon being exposed to a lower pressure such as is obtained in the condenser. If the condensate line from the heater is submerged the rapid change in volume due to flashing will cause a great deal of turbulence, as the velocity will be high. This turbulence in the hotwell will extend into the condensate pump suction line, causing a decrease in pump efficiency.

I suggest that the heater drain be connected in the shell above the tubes, or in the connecting piece between condenser and turbine. If this is not possible it will be satisfactory to connect the drain into the shell next to the tube bank, providing some sort of baffle is used to stop the impingement of flash steam, with its minute particles of water, upon the tubes, as this would cause serious erosion.

I recommend a U-trap for draining the heater. However, it must be remembered that the U-trap will have to be designed for the highest pressures under which the heater will operate. It is recommended that at least 18-in. difference in elevation should be maintained at the heater end to provide sufficient head to overcome friction when the load on the turbine is light and the difference in pressure between condenser and heater is reduced.

The discharge leg of the trap should be at least 23-ft. high.

HAROLD A. BRADSHAW.

Easton, Pa.

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AN INVERTED SYPHON or loop would offer the simplest method of draining the heater, provided there is sufficient vertical space available below the point of connection to the hotwell. In this case the length of the loop would be (29-10) × 1.136 = 21.6 ft. It would be advisable to add a few feet to the length to provide for lower pressures at the bleed point at light loads.

If sufficient space is not available for the loop, a trap or drainer of the continuous-flow type would be satisfactory. Thermally it would be more economical to pump the heater drains into the feedwater line at the outlet of the heater.

H. A. PIETZNER.

Evansville, Ind.

THE ENGINEER'S

Foresight and Business

BUSINESS ADRIFT. *By Wallace Brett Donham, dean of the Graduate School of Business Administration, Harvard University. With an introduction by Alfred North Whitehead, professor of philosophy at Harvard University. Published by Whittlesey House, McGraw-Hill Book Company, 370 Seventh Ave., New York City; 1931. Cloth, 6x9 in.; 196 pages. Price, $2.50.*

WITH MORE than usual penetration and integrity, this book analyzes the weaknesses inherent in our economic system and presents a possible plan for overcoming them. It is fundamental in its approach to the problem, yet practical enough to recognize the limitations of any solution that might be offered.

In his introduction on "Foresight" Professor Whitehead points out the increasing importance of the factor of change in our social structure and the necessity of maintaining sufficient routine to insure stability. He emphasizes the inescapable interrelation between business and other elements of our civilization and shows how progress depends upon the quality of foresight possessed by business leaders. Foresight, he writes, depends upon understanding—the ability to survey society from the standpoint of generality—and is essentially a philosophic habit of mind.

Applying foresight to business problems, Dean Donham discusses short-time planning, middle-period planning and long-time planning, with the conclusion that planning for the middle period will be most effective because it allows "fixing" the number of variables involved. From a careful consideration of all factors threatening our economic well-being, he condenses the problem in the following statement:

"How can we as business men, within the areas for which we are responsible, best meet the needs of the American people, most nearly approximate supplying their wants, maintain profits, handle problems of unemployment, face the Russian challenge and at the same time aid Europe and international peace?"

To solve this problem he proposes a plan for American business based on security and leisure for all and the development of the home market. His cure for unemployment is "work," provided, if necessary, by government building in times of business depression. His answer to the Russian challenge is development of the home market in preference to competition for foreign markets and the raising of American standards of living. He insists, however, that one of the most important factors in overcoming economic difficulties is the quality of business leadership.

Such leadership, to be effective he points out, must appreciate and understand the relation of business to civilization; it must have a broad-vision sense of social responsibility; possess the knowledge and foresight to formulate valid and comprehensive economic plans, and most important of all, be capable of so administering such plans that a fine balance between individual initiative and disciplined cooperation is maintained.

While Dean Donham expects much of his business contemporaries—perhaps more than they are able to give at present—his commentary on our economic system is one of the most intelligent and forward-looking yet presented.

Hydraulic Engineering

HYDRAULICS FOR ENGINEERS. *By Robert W. Angus, professor of mechanical engineering, University of Toronto, Canada. Published by Isaac Pitman & Sons, 2 West 45th St., New York City; 1930. Cloth, 6x9 in.; 304 pages, 161 illustrations. Price, $3.50.*

AN OUTSTANDING FEATURE of this book is its practical presentation. Most books on hydraulics begin with an extensive discussion on hydrostatics, but in this work the subject has been largely omitted and the few features of it that are necessary are worked out as the occasion requires. The book is divided into three parts: the first dealing with flow of water in pipes, orifices, weirs and open channels; the second, hydraulic turbines and centrifugal pump; and the third, non-uniform flow.

The practical treatment and the subjects covered reflect the author's many years of experience as a practicing hydraulic engineer and teacher. As he says in the preface, he has ventured to set down the methods he has found to be successful and that have been used in his engineering work. The chapter subjects are fundamental equations and measurements; friction loss in pipes and fittings; calculation of the flow in pipes; measurement of water by orifices, weirs, Gibson and Allen methods; flow in open channels and design of channels; gaging the flow in open channels; fundamental equations and conditions for turbine efficiency; power of turbines; regulation of turbines, propeller and Kaplan turbines, impulse wheels; modern hydro-electric installations; turbines and centrifugal pumps; non-uniform flow in open channels, back water, economical design; water hammer in pipe lines, Allievi and other formulas, relief valves; unsteady flow in pipes, surge tanks, method of calculation; hydraulic models; distribution of flow in curved channels; and water surfaces in a rotating vessel.

Realizing that practicing engineers usually forget their purely mathematical training, effort has been made by the author to deal with the subjects without introducing difficult mathematics and there is scarcely a section in the book involving more than a knowledge of quadratic equations. In the early part of the book the problems are treated as a special application of the fundamental head equation, derived at the beginning. Turbines and pumps have been treated more extensively than is usual in a book of this character, and applications of their principles have been made to practical problems. At the end of most of the chapters, problems are given so that the student may apply the principles laid down. Answers to the problems are included in an appendix so that the student may test his understanding of the subjects.

The book contains much to recommend it to practicing hydraulic engineers and students. It should find a wide audience with these readers.

Patent Law for Engineers

PATENT LAW FOR CHEMISTS, ENGINEERS AND EXECUTIVES. *By Fred H. Rhodes, professor of industrial chemistry, Cornell University. Published by the McGraw-Hill Book Company, 370 Seventh Ave., New York City; 1931. Cloth, 5½x8 in.; 207 pages. Price, $2.50.*

WRITTEN for those engaged in technical and administrative work in industry, this book presents a broad, understandable treatise on the law of patents, the requirements for a patentable invention and the rights conferred by a United States patent. The author begins with a discussion of the development of patent law and its application to invention and discovery. He then takes up the types of inventions that are patentable, together with the general details of securing a patent in this country. Subsequent chapters deal with the rights conferred by a patent, infringement suits, testing the validity of a patent and policy in respect to patents.

Numerous citations from court decisions are given in the book to illustrate and substantiate the various points brought out. The text proper, however, is kept as free of technical legal terms as possible, to make the book more readily understandable to the legal laymen. For the same reason, special matters that are usually handled by experienced patent attorneys, such as the formal procedure to be followed in patent litigation, are touched upon only comparatively lightly.

BOOKSHELF

Marine Diesel Practice

PRACTICAL MARINE DIESEL ENGINEERING. *Second Edition. By Louis R. Ford, consulting engineer. Published by the Simmonds-Boardman Publishing Company, 30 Church St., New York City; 1931. Cloth, 6x9 in.; 746 pages, 478 illustrations. Price, $7.*

THE FIRST EDITION of Mr. Ford's well known and excellent treatise on marine diesel engines has been so rewritten that this second edition might well be termed a new book. The author has covered the general design and layout of most of the better known marine diesels of both domestic and foreign manufacture, which is an excellent procedure, for due to the tendency of American shipping firms to purchase hulls and engines abroad, American engineers are almost anytime likely to face the operation of a foreign engine.

By reason of Mr. Ford's drydock and sea experiences he has acquired an intimate knowledge of the defects most of the large diesels are prone to develop. His suggestions as to methods of repairs and adjustments are consequently of great value.

Taken as a whole, no better volume dealing with the marine diesel has been published either in this country or Europe. Only one criticism can be offered: there are several poor illustrations. The blame for that, however, rests on the publisher, not the author. Anyone now in charge of a motorship, or desirous of becoming familiar with motorship machinery, will find the volume a mine of information.

A New Thermodynamics Text

ELEMENTS OF THERMODYNAMICS. *By Ernest M. Fernald, assistant professor of mechanical engineering, Lafayette College. Published by the McGraw-Hill Book Company, 370 Seventh Ave., New York City; 1931. Cloth; 6x9 in.; 329 pages; 168 illustrations. Price, $3.50.*

ACCORDING TO THE AUTHOR the book is planned to impart: "An adequate and flexible technique for quantitative dealing with various situations, together with data sufficient for simpler ones; and clear ideas as to the limitation of engineering practice by universal laws, and as to the conditions that must be met before current practice can approach the ultimate." From this the purpose would seem rather obscure, nevertheless it is evident the book is intended as a college text on thermodynamics.

Throughout, the author has an interesting way of showing the practical application of thermodynamic principles to engineering. The properties of steam, simple thermodynamic steam processes and ideal steam cycles are treated before consideration is given to the properties of perfect gases, and gas cycles. Compressed air, refrigeration and internal combustion engines are briefly treated.

Generalization concerning available energy and the second law of thermodynamics is placed late in the book, the student being led up to the second law instead of down from it. This generalization is followed by a chapter on flow through nozzles, tubes and orifices.

Oil Burning Practice

HANDBOOK OF OIL BURNING. *By Harry F. Tapp. Published by the American Oil Burner Association, 342 Madison Ave., New York City; 1931. Leatherette, 5x7 in.; 629 pages, 358 illustrations and 123 tables. Price, $3.*

INFORMATION of great practical value to the power engineer, fireman or mechanic whose work requires a knowledge of industrial, commercial or domestic oil-burner installations is contained in this new handbook. Besides authoritative data, charts, tables and descriptive illustrations relating to every phase of the oil-burner industry, the book discusses in detail the application of oil burners to different industries such as ceramics, chemical plants, factories, foundries, machine shops, steel furnaces, etc. Oil burner types and principles of construction and oil burner controls and motors are explained in detail.

The book also contains a wealth of general information such as the fundamentals of heat and heat transfer, the chemistry of combustion and flame, the determination of heating capacity requirements and comparative fuel costs.

BRIEF REVIEWS

HANDBOOK OF SCRAPER MUCKING. Publication No. 176 of the Sullivan Machinery Company, 400 North Michigan Ave., Chicago, Ill.; 118 pages, illustrated; price, $2.—Comprehensive information, compiled from field studies and engineers reports, on the subject of scraper mucking in metal mines. The book also contains some data on tunnel driving and scraper loading in coal mines.

TREATMENT OF WATER FOR ICE MANUFACTURE. By Dana Burks, Jr. Published as Bulletin No. 219 of the Engineering Experiment Station, University of Illinois, Urbana, Ill.; 114 pages, illustrated; price, 60c.—Two methods of treating any characteristic sodium bicarbonate water source so that it may be used in the production of marketable manufactured ice are described in detail in this report.

HEAT-FLOW METERS AND THERMAL CONDUCTIVITY MEASUREMENTS. By F. G. Hechler and E. R. Queer. Bulletin No. 37 of the Pennsylvania State College Engineering Experiment Station, State College, Pa.; 60 pages, illustrated; price 50c.—A description of the various types of heat-flow meters, together with their application to the measurement of the thermal conductivity of different building walls.

STORAGE RESOURCES OF THE SOUTH AND MIDDLE FORKS OF KINGS RIVER, CALIFORNIA. By Ralph R. Randall. Published by the Federal Power Commission, Washington, D. C.; 57 pages; illustrations, maps and tables.—A report on the potential water storage resources of the region, including estimates of the amount of hydro-electric power that may be developed.

FLOW OF LIQUIDS IN PIPES OF CIRCULAR AND ANNULAR CROSS-SECTIONS. By A. P. Kratz, H. J. MacIntyre and R. E. Gould. Bulletin No. 222 of the Engineering Experiment Station, University of Illinois, Urbana, Ill.; 26 pages; charts and tables; price 15c.—Results of an investigation to determine the relation between the friction factor and Reynolds' number in wrought-iron pipe and channels of annular cross-section, also the head loss resulting from the use of cast-iron elbows.

OIL FILM PRESSURES IN A COMPLETE BEARING. By L. J. Bradford and L. J. Grunder. Bulletin No. 39 of the Pennsylvania State College Engineering Experiment Station, State College, Pa.; 50 pages, illustrated; price 50c.—The report of a study undertaken to determine the actual film pressures within a complete journal bearing, lubricated from one end, and also to determine the running positions of the journal.

ECONOMIC HANDBOOK OF THE SOVIET UNION. Published by the American-Russian Chamber of Commerce, 261 Fifth Ave., New York City; 151 pages; tables and maps.—Contains up-to-date statistical data on the development of various branches of industry, agriculture and transportation in Soviet Russia, together with a comprehensive analysis of the results of the first two years of the five-year plan and some of the schedules of the 1931 program.

Midwest Coal Interests Meet at Urbana

AT THE Midwest Bituminous Coal Conference, held this year at the University of Illinois, Urbana, Ill., on May 21 and 22, an important event was the presentation and general acceptance of minimum setting heights for heating boilers equipped with mechanical stokers burning Midwest coals. Other contributions to an unusually full program including nineteen papers and seven prepared discussions dealt with domestic and industrial utilization of Midwest coals, determination of relative values of different coals, comparisons with other fuels such as oil and natural gas, research programs, performances in the field, development of the small stoker, and kindred subjects.

BROADENING out from the Indiana fuel conferences of some years standing to include the fuel interests of Illinois, the Midwest Coal Conference is now sponsored by the University of Illinois and Purdue University in cooperation with the Coal Trade Association of Indiana, Fuels Division of the American Society of Mechanical Engineers, Illinois Coal Bureau, Illinois State Geological Survey, Midwest Stoker Association, National Association of Power Engineers and the National Association of Purchasing Agents. Indication of the interest in this movement, instigated to increase the use of Illinois and Indiana coals and to discuss the new problems involved, is apparent from a registration of 325.

To determine the relative value of coals W. D. Langtry emphasized the importance of accurate sampling and analyzing in conjunction with evaporative tests and, in some cases, heat-balance runs in the plant. In his opinion, ways can be found to broaden the industrial and domestic use of the coals of the two states. Commenting on the subject, G. H. Cady thought it important to establish unit coal valves at the mines. Face sampling, he thought, is essential to determine the efficiency of the cleaning process. In measurement of the value classification more information should be demanded than the simple proximate analysis. He favored a geological analysis such as would be made of rock. Two paths are open for increased production and use: lowering the cost to the consumer and increasing the suitability.

Comparative Cost of Gas, Bituminous and Anthracite

In three papers relative values of fuels were compared. In the many tests conducted at the Research Residence in Urbana, Prof. A. C. Willard has found that the cost of gas fuel is approximately 2.9 times that of soft coal and 1.8 times that of anthracite. Tabulated data gave the following relative cost of the heating dollar: 82 to 100 for soft coal, 150 to 160 for anthracite and 290 for gas. Per ton the anthracite coal cost $16.50, and the bituminous coal $6.50 to $9.25. Gas with 565 B.t.u. per cubic foot cost 75c. per 1,000 cubic feet.

Tests by E. F. Clemens in the burning of sewer pipe in two 30-ft. kilns of the round down-draft type with southern Indiana coal and natural gas, under identical conditions, showed the cost per ton of ware burned approximately double for gas, although the thermal efficiency was higher and the quality of the ware somewhat better. Labor costs were about the same. Initial cost and maintenance were higher with gas. About 100 lb. of southern Indiana coal was equivalent to 1,000 cubic feet of natural gas. The average heat requirements per ton of ware were: for gas, 9,500,000 B.t.u.; for Patoka coal, 10,000,000 to 14,000,000 B.t.u.

Cost Halved by Stoker-Firing

Discussing this paper, Joseph Harrington referred to the external application of a stoker to a paving brick kiln that had increased the useful kiln space 30 per cent and by efficient, smokeless operation had approximately halved the cost of fuel over hand-firing.

Comparative tests conducted according to A.S.M.E. standards in two hotel heating plants on oil and stoker firing showed a 35 per cent saving in favor of coal. The oil cost 4¾c. per gallon and the coal $5.15 per ton delivered. Fuel cost per 1,000 lb. of steam ranged from 40 to 44c. for oil and 24 to 28c. for coal. A long summary of results was presented by G. I. Methe. Owing to these tests stokers replaced the oil burners and showed a saving of over 30 per cent on the investment.

Centralized Domestic Distribution

Central preparation and distribution of pulverized coal to domestic and industrial consumers was a subject treated at some length by C. W. Callaghan, of Sioux City, Iowa. In that city coal pulverized so that 83 to 85 per cent will pass through a 300-mesh screen is delivered in truck tanks containing air under 40 to 50 lb. pressure. This pressure forces the coal through a hose to the tank of the consumer. A 24-hour service is maintained, including ash removal by a vacuum cleaner. Charges per gallon are 4½c. to the domestic consumer and 2½c. for industrial use, equivalent to $18 and $10 per ton, respectively. Compared with hand firing of raw coal, the tonnage consumption is reported to be 50 per cent. The initial cost of the equipment for any type of domestic furnace was given as $350.

A dramatic moment in the conference was the presentation by D. R. Mitchell of Prof. S. W. Parr's last message to the coal world—a paper dealing with the future of Midwest coals that had been completed just an hour before his death on May 16. Research, he said, would tell how to build up the market for these coals. Immediate relief lies in applying research work that already has been done. Coking Illinois coal will provide a high-grade substitute for anthracite and cleaning the coal will give a fuel lower in ash, the paper stated. In the future, he believed, less and less coal will be used in the raw state. Pulverized-coal explosion motors will be improved. Coal tars will be more in demand as the raw products for other uses. Securing hydrogen from coke oven gas will be a profitable project, and there will be large demand for nitrogen as a fertilizer. To develop other products from coal, fundamental research must be continued, Mr. Parr's paper insisted.

Aims of the Committee of Ten

Following this paper, Dr. M. M. Leighton reviewed the coal research program of the Illinois Geological Survey in a state ranking ahead of 41 others in the production of mineral products. C. B. Huntress introduced the Committee of Ten, which has been organized, from the coal and heating industries and established a home in Chicago in March to advance the use of solid fuel. Oliver J. Grimes, managing director of the committee, outlined its activities and purposes as entirely advisory and educational. The committee collects data on research and consumer service relating to solid fuel utilization.

and disseminates such information among members' organizations.

L. A. Snider, consulting engineer for the State of Illinois, approximated space requirements for coal-burning plants as follows:

For high-pressure stoker-fired water-tube-boiler plants with mechanical coal and ash handling and overhead storage bunkers, he gave these figures in cubic feet per normal rated boiler horsepower of 10 sq.ft. of surface: boiler and pump rooms, 76; coal- and ash-handling equipment and storage bunker, 54; total boiler plant space, 130; coal-storage capacity in bunkers, 356 pounds.

Building space in cubic feet per boiler horsepower for high-pressure stoker-fired horizontal tubular boilers without mechanical coal and ash handling was: boiler and pump rooms, 137; coal storage, 19; total boiler plant, 156; coal storage capacity 640 pounds.

Low-pressure heating plants with portable type of steel firebox boilers, stoker- or hand-fired, had these average requirements in cubic feet per boiler horsepower: boiler and pump rooms, 45; coal storage, 15; total plant, 60; coal storage capacity, 500 pounds.

For low-pressure heating plants with cast-iron sectional boilers, stoker- or hand-fired, the space requirements per square foot of cataloged boiler rating are: boiler room, 0.23; coal storage, 0.20; total plant space, 0.43; coal-storage capacity, 75 pounds.

Recommended Setting Heights

A constructive piece of work badly needed in the small-stoker field was the establishment and presentation to the conference of recommended setting heights for firebox, compact welded, and return-tubular boilers by E. L. Beckwith, chairman of the engineering committee of the Midwest Stoker Association. In formulating the tables a heat release not to exceed 50,000 B.t.u. per cubic foot of combustion volume per hour was made the basic factor. Roughly, this is equivalent to 1 cu.ft. of furnace volume per developed horsepower, assuming 70 per cent efficiency. Preparation of similar data for cast-iron sectional boilers is to be made the work of the coming year.

"A Step in the Right Direction"

Discussion headed by Joseph Harrington, T. A. Marsh and J. H. Walter agreed that establishment of setting heights for Midwest coals was a step in the right direction. Owing to the difference in the fuels it was understood that Eastern practice purposely had been avoided. The tables will give a working basis until research modifies the data. Other factors to be considered are fuel and air distribution, proper mixture of air and gases, slag drainage, the amount of refractory desirable in the furnace, and the more specific design of stokers for Milwest coals.

Commenting on heating plant tests. H. C. Carroll stated that too many stokers were installed without knowing definitely the conditions under which they are to operate and the quality of the nearest suitable coal. Definite savings can be established if definite guarantees are exacted in the performance of stokers with coals available in the locality. Data submitted on coal costs in office buildings and apartment hotels with stoker installations burning Illinois screenings costing $5.15 per ton delivered ranged from 10 to 19c. per square foot per season.

Results of Stoker Tests Revealed

From the results of a series of tests made at Kewanee, C. E. Bronson made a number of observations on the performance of stokers in firebox boilers. For the most part, efficiencies of 74.5 to 77.5 per cent have been obtained. The maximum rate of heat release without smoke has been 50,000 B.t.u. per hour per cubic foot of furnace. It seems more attention has been paid to the feeding of the coal than to the proper design of the retort for correct fuel and air distribution, which the speaker considered the important factor in maintaining good combustion conditions. Selection of the correct size of stoker for the load is essential, and for economical operation the stoker should be designed to burn screenings, so that it will be unnecessary to resort to the use of nut coal.

Prof. G. A. Young and W. T. Miller summarized jointly many tests that had been made at Purdue University to determine the adaptability of nine grades of Indiana coals to five of the small stoker installations. Each of the coals was found to be reliable for continuous twelve-hour automatic operation with any one of the stokers. Combustion rates ran from a heat release of 25,000 to 36,000 B.t.u. per cubic foot of furnace volume with four of the stokers, and 45,900 B.t.u. with the overfeed stoker, the latter corresponding to over 300 per cent of rating. Power requirements for feeding the coal into the furnace ran from 5 to 13.5 kw.-hr. per ton.

No Substitute for Good Engineering

In the final session of the conference, devoted primarily to industrial utilization, Lisle A. Pierson intimated that even the poorest of the Continent coals can be burned satisfactorily and profitably if the equipment is properly engineered. It was his contention that no one particular design of furnace is a cure for all the ills of combustion.

Midwest Coal Combustion Tests

In a paper on "Midwest Coal Combustion Tests," Prof. A. P. Katz gave what constituted an abstract of the University of Illinois Engineering Experiment Station Bulletin No. 213, which compared the characteristics of northern and southern Illinois coals for steaming purposes. Better results were obtained with the southern coals, but the differences were so slight that there is no reason why the northern mines should not open up and operate with as much confidence as those in the southern part of the state.

Under the same title, but this time referring to Indiana coals, Dean A. A. Potter of Purdue University, summarized 67 tests on a variety of equipment. The results are to be found in Bulletin No. 26 of the Indiana Engineering Experiment Station. The tests indicated that over-all boiler efficiencies of 79.2 per cent may be obtained with Indiana coal when used in connection with water-tube boilers and forced-draft mechanical stokers. Hand-fired boilers showed efficiencies as high as 69.6 per cent. Boiler capacities as high as 176.6 per cent rating were secured with mechanical stokers, while hand-fired grates could not be operated above 133 per cent. Improvements in stokers and other equipment since the time of the tests, 1925-26, should make higher efficiencies possible. Storage studies may be found in Bulletin No. 30. Studies of the causes of spontaneous conbustion in Indiana coal are now under way, as well as investigations of mining, with a view to initiating methods of cleaning and classification.

W. J. Woodruff reviewed what had been done to remodel two of the University of Illinois heating plant boilers originally equipped with natural-draft chain grates and relatively low settings. By raising the boilers to give a head-room of 14 ft., changing the baffling, and equipping the boilers with forced-blast chain grates and air preheaters, the fuel consumption was reduced approximately 20 per cent. The new installation gave nearly a flat curve showing 79.4 per cent efficiency. Under average normal operation with coal costing $2 per ton in the bunker, the fuel cost per 1,000 lb of steam is 15 cents.

Educating Operators

Prof. A. W. Cole, of Purdue University, gave an interesting account of how power-plant operators were trained in Indiana by means of extension courses conducted at various centers in the state and at the university. As all industrial plants differ one from the other, he deemed it advisable and desirable to train new men above the laboring class on the job regardless of their previous experience. They should begin at the bottom of their respective classes. Their proficiency should be tested continually, and, if they are to render their best service, they should be given every opportunity to see what is ahead of them in the way of promotion. As a means of arousing curiosity and enthusiasm, he is a great believer in explaining operating principles and the reasons back of the daily routine, for, after all, the skill and enthusiasm of the operator has more to do with the efficiency of the plant than the equipment.

Preparation of Coal Defined

A paper by John A. Garcia and H. B. Cooley defined what good preparation of coal means. Grading of Midwest coals has been so perfected that practically all company mines can supply four sizes. Although the establishment of washing plants would give coal as

low in ash as Eastern coals, the Middle West has lagged behind certain other districts, owing to the expense involved. On the average the fixed operating cost of a washing plant amounts to 15c. per ton, and on top of this a charge of 4c. per ton for each 1 per cent reduction in the ash, assuming the cost of the coal to the operator at $1 per ton. Thus the washing charge might readily add 30 to 50c. to the price of a ton of coal. It was considered important to determine the washability of the coal at each mine and also to determine the variation of the impurities in the product. In Illinois nothing is being done to clean coal under 2-in. size. Above this size impurities are being removed by hand picking.

Next year the Midwest Bituminous Coal Conference will be held at Purdue University, Lafayette, Ind.

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Special Alloys Used to Repair Waterwheels

AT A RECENT MEETING of the Pacific Coast Electrical Association's Hydraulic Power Committee, held in Fresno, Calif., a report by J. M. Gaylord on "Special Alloys for Hydraulic Equipment" was read by J. F. Davenport. The opinion expressed in the paper is that the application of special and hard-faced alloys to hydraulic equipment is still in an experimental stage, but sufficient data have been collected to prove that the application of hard-facing metals to turbine parts subjected to high pressure is economically sound. The San Joaquin Light & Power Company has experimented with stellite, applying it to needles and throat rings at Balch, Crane Valley No. 1 and Tule River power houses. At the Balch plant the stellite needles and throat rings have been installed for a sufficient period to give an indication of the life of hard-faced parts. The steel needles and throat rings at this plant last approximately three months, after which time it is necessary to replace them, as a result of the cutting action of the water. Bronze rings lasted no longer than steel.

In January, 1928, at the Balch plant a needle 8⅛ in. in diameter and throat ring were treated to a surface of stellite. The ring was replaced in February, 1930, when it was decided that a larger-diameter throat ring should be installed. The stellite ring, which had been operated for a period of two years, was found to be still in excellent condition.

Reports from the Big Creek 2A plant state that stellite needles and throat rings are in first-class condition after having been subjected to continuous service for a period of over two years. It may be necessary after six months to do some slight grinding to prevent a fine spray leakage. At this plant bronze parts lasted for less than three months. The Southern California Edison Company has applied other materials, such as chromium, stoodite, nitralloy and durite. Chromium plating is applied to needles and throat rings at two stations, but the experiment was not successful, because the plating peeled off. Stoodite has been used successfully and apparently has wearing qualities similar to stellite. Nitralloy needles and throat rings have been in use at the Big Creek plant and apparently give satisfactory service. Durite needles are in service at Santa Ana River No. 1 power house and are giving good service. The report contained a fairly detailed account of the properties of these various materials and their method of application.

Mr. Davenport questioned G. H. Bragg regarding his experience with hard-faced alloys, to which the latter replied that his experience had been with chromium plating, nitralloy and stainless steel. The chromium plate appears to be successful; however, it must be properly applied or peeling will take place. Attention was called to a small chromium-plated water motor that had been operating approximately 1½ yr. with no sign of wear on the parts. As to the cost of this process, it was stated that observation would indicate approximately $1 per lb. for nitralloy or chromium plate. Chromium plating on bronze was tried, but it was found unsatisfactory, although the application was much more satisfactory on steel. Nitralloy is being tried out at the Bucks Creek plant, but experience is insufficient to report at this time.

Organize Russian Trip to Study Trade Possibilities

DURING THE SUMMER OF 1930 Dr. Henry R. Seager, professor of political science at Columbia University, and a group of economists and business men went to Russia to make a study of the Soviet Five-Year-Plan of the possibilities for future Soviet-United States trade. Those who made this trip were unanimous in the opinion that the Russian market is rich with opportunities which are to be had for the asking. Dr. Seager made arrangements with Soviet officials to interview American business men who might visit Russia during the summer of 1931 and discuss these opportunities with them. Roy H. Mackay, economist and authority on Soviet affairs, is carrying out these arrangements and extends an invitation to American manufacturers, engineers and economists to visit Russia during the coming summer and make a conservative study of the Russian market.

A program of thirty days, from Berlin back to Berlin, has been arranged. For the convenience of those who wish to make the trip the party will be divided into two groups, the first to leave Berlin on July 15 and the second on July 25. Conferences will be held with Soviet officials and American engineers and builders in the principal industrial centers. Representatives of the Soviet government and American economists who have made a thorough study of Soviet economy will accompany both groups so that the situation may be understood from all viewpoints.

Business men, economists, engineers and builders who are interested in joining one of these groups should communicate with Roy H. Mackay, Fayerweather Hall, Columbia University, New York City.

Smaller Industries Meeting At Lake George, Aug. 10

FOR THE FIRST TIME in the industrial history of the United States there is to be a convention of the smaller industries of the country. This gathering will be held on Aug. 10 at Lake George, N. Y., and the organizers expect it will be an important step toward the solution of some of the problems of management that are confronting the smaller manufacturing industries.

The significance of this convention was pointed out in a statement issued May 14 by the National Industrial Conference Board, sponsor of the meeting, showing that, according to the latest available census figures, only 3.4 per cent of all manufacturing establishments in the United States employ more than 250 wage earners and only 1.4 per cent employ more than 500. Of still greater importance is the fact that 62 per cent of all industrial wage earners are employed in plants having a working force of 500 or less.

Heretofore the factor of size has been largely ignored in conferences on management problems, according to the statement, and the large-plant view has tented to dominate the discussions because greater attention has been paid to the questions under consideration by the large plants. This has worked to the disadvantage of executives of smaller plants, who, while interested in what they have heard, have frequently failed to gain from it anything of practical assistance to themselves or their organizations. It is for this reason that the coming conference has been organized.

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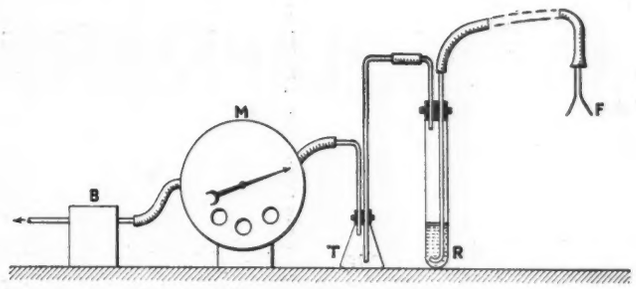
THE STEAM TEMPERATURE at the boiler outlet of the Clarence Dock station in Liverpool, England, is 750 deg. F., not 25 deg. F. as stated on page 543 of the April 7 issue of *Power*. It may be raised at some future time to 825 deg. F. if desired.

Determination of Sulphur Gases in Air

UNDER normal conditions the sulphur in air appears to be present almost entirely as sulphur dioxide, the amount of sulphuric acid usually being negligible. The sulphur dioxide can be determined by absorption and fixation as sulphuric acid in an aqueous solution of hydrogen peroxide, the most convenient form of the peroxide being the solid compound of perhydrol and urea known as hyperol (Berk). Air can be bubbled at a rapid rate through this solution with complete absorption of sulphur dioxide. A process based on the same principle, but using hydrogen peroxide itself as oxidizing agent, was described and used in 1891 by the late Dr. G. H. Bailey. The details of the process now described were worked out by the government chemist (who has used it for sometime) for the Atmospheric Pollution Research Committee of the Department of Scientific and Industrial Research (London, Eng.) The arrangement of the apparatus is illustrated in the sketch.



Sketch of the apparatus used

Air is collected from the desired source by means of a glass or rubber tube from which a small glass funnel *F* depends, serving to prevent rain or gross dust from getting into the absorbing vessel. It then passes through the absorbent solution, which is contained in a reaction tube *R* of stout glass (a boiling tube) about 1½ in. diameter and 10 in. long, fitted with a rubber two-bored bung, carrying a tube reaching to the bottom and with a shorter tube in the second hole reaching only just through the bung. After leaving this vessel the air passes through a conical flask *T* of about 250 c.c. capacity, serving as a trap, and thence to a gas meter *M* capable of registering 100 cu.ft. This may be a small dry meter such as is used for small domestic services, and must be of at least the degree of accuracy required by statute for this purpose—that is, it should bear the seal of a competent testing authority.

The air is drawn through the apparatus by means of a suitable pump *B*, which may be an electrically driven blower, used as an exhaust, or an ordinary laboratory water pump.

It has been found convenient to support the reaction vessel and a duplicate tube, in which a comparison solution is placed, in a wooden box stand, which keeps them in an upright position and screens the solution from the action of light. The necessary connections are made with rubber tubing.

To make a determination, take as much distilled water as will fill the reaction tube to about 6 in.; add about 1 gram of hyperol; and when it has dissolved divide the solution equally between the reaction vessel and the comparison tube. Connect the reaction tube to the tube introducing the air and to the conical flask. Note the reading of the meter and the time. Start the pump and adjust the rate of flow of air through the apparatus to about ½ cu.ft. in 15 min., which is approximately 50 ft. in 24 hr. Where the air is likely to be exceptionally pure this rate may be increased, but it is inadvisable that the rate should exceed 100 cu.ft. in 24 hr. At the end of 24 hr. stop the suction; read the meter and add to the liquid in the reaction tube 3 or 4 drops of 4.5 indicator (British Drug Houses) and exactly the same amount to the comparison tube. The liquid in this second tube is to be brought to a steel gray by the addition of a known amount, added dropwise, of N/250 acid or alkali. The liquid in the reaction tube, which will be more or less red in color, owing to the sulphuric acid formed by oxidation of the sulphur dioxide absorbed from the air, is now to be titrated with N/250 alkali until it is of exactly the same shade as that in the comparison tube. The volume of N/250 alkali required to do this minus the volume of alkali or plus the volume of acid used to produce the same tint in the comparison tube is that needed to neutralize the acid gases present in the volume of air passed through the apparatus.

CONVERSION TABLE FOR SULPHUR IN AIR

	Grains Sulphur/ Cubic Foot	Milligrams Sulphur/ Liter	Volumes SO_2/1 Million Volumes
1 grain sulphur/ cubic foot.....	1	2.3	1,610
1 milligram sulphur/liter.....	0.436	1	700
1 volume SO_2/1 million volumes	0.00062	0.00143	1

Since the indicator used is not affected by carbonic acid in the proportions found in air, it may be assumed that all the acidity is due to sulphur acids. On this assumption the following formula will give the volume of sulphur dioxide in one million volumes of air.

$$SO_2 \text{ in parts per million} = \frac{1.502 \times \text{number of ml. of N/250 alkali}}{\text{Cubic feet of air passed}}$$

For the purpose of determining the sulphur gases in the air during a short period only, should that be desired, a second absorbing vessel should be introduced between *R* and *F*. In this case 1.5 grams of hyperol should be dissolved in 1½ times the usual volume of water and one-third of the solution brought into each of the absorbing vessels, the remaining third being retained for comparison. The correction for standard tint should be applied to the result of titrating each tube. In other words, the total volume of N/250 alkali required for the two tubes minus twice the volume of alkali or plus twice the volume of acid required for the comparison tube is that required to neutralize the acid gases in the air. The rate of flow of air should be such as to allow 20 cu.ft. to pass through the apparatus during the desired time, but after some experience the analyst may find that this volume can, without much error, be reduced.

If it is desired to verify the nature of the acidity as due to sulphur, the two liquids after titration may be evaporated to small bulk acidified with hydrochloric acid, using the same amount for each, and the sulphate precipitated by barium chloride. The barium sulphate in each case is collected and weighed and the difference between the weights found taken as that due to the sulphur gases in the air. One milligram of barium sulphate corresponds to 3.38 millionths of a cubic foot of sulphur dioxide. If it is desired to do this the acid, if any, used to adjust the color of the comparison tube must not be sulphuric, and the sulphur content, if any, of the standard alkali used should be known and allowed for.

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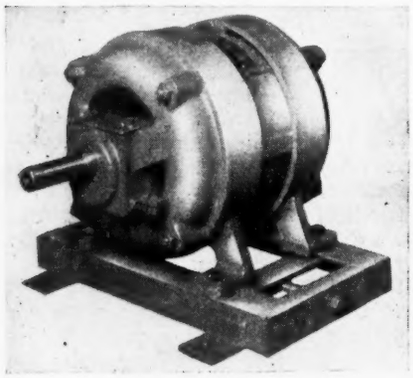
NEW ORDERS for pulverizers for pulverized-fuel equipment in April, as reported to the United States Bureau of the Census, aggregated 13 pulverizers having a total capacity of 118,250 lb. of coal for contract, as compared with 19 pulverizers in March having a total capacity of 189,250 lb. of coal for contract.

WHAT'S NEW IN PLANT EQUIPMENT

Welded-Steel Motor Base

WELDED-STEEL motor bases of one-piece construction to take the place of slide rails are now being put out by the Lincoln Electric Company, Cleveland, Ohio. They are



Motor mounted on welded base

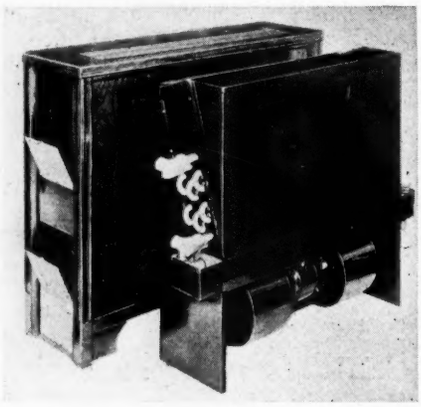
constructed of rolled steel angles and flat bar stock fused into one unit by an electric arc. The flanges of the angles, to which the motor is bolted, are slotted to permit moving the motor on the base for purpose of tightening the drive belt. Drilled angles arc-welded to the sides form hold-down lugs for securing the base in position.

Atmospheric Cabinet to Take the Place of Radiators

DESIGNED to heat or cool, humidify or dehumidify and ventilate, a new unit, designated atmospheric cabinet, now being put out by the Carrier-York Corporation, 1541 Sansom St., Philadelphia, Pa., can be used to replace standard types of radiators now in use.

The present supply and return lines of steam or hot-water heating systems can be used for the new unit with the addition of a small water supply and drain line for humidification. To provide for cooling, the installation of supply and return lines from a source of refrigeration is the only piping required.

A pan-shaped humidifier is located between the heating coil and the motor and fan assembly, a filter for clearing the outside air and a heat transfer coil by means of which either recirculated or outside air may be heated or cooled, are additional

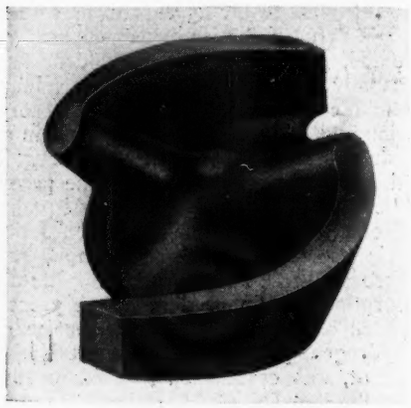


Unit with exterior cabinet removed

features. Humidity regulation is obtained by adjusting the overflow control on the end of the humidifier. Small doors at each end of the cabinet provide ready access to the controls.

Industrial Centrifugal Pump

AVAILABLE IN ELEVEN SIZES, four styles and four constructions, providing around 150 different pumping combinations, the new "Flexi-unit" pumps put out by Goulds Pumps, Inc., Seneca Falls, N. Y., are adapt-

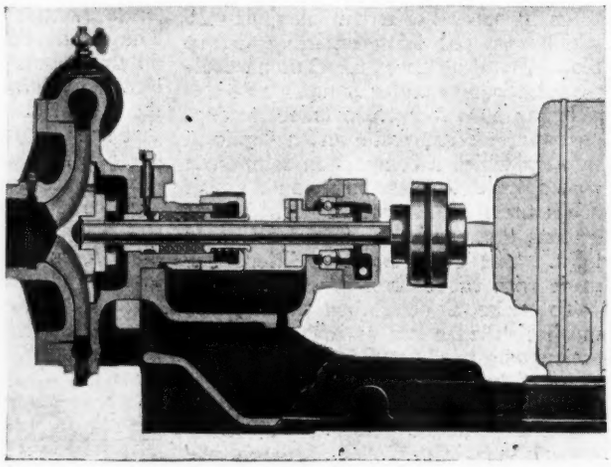


Non-clogging impeller

able to practically every requirement in the industrial field.

An important feature of the pumps is the use of a special design of bedplate which allows mounting and alignment of both pump and motor without the use of shims or blocks. The propeller is of the open, nonclogging type, hydraulically balanced to minimize end thrust. It is secured to the shaft by bolting at the back wall to a large flange forming part of the pump shaft. The inner bearing and seal ring have outside connection for clear water or lubricant, and an unusually deep stuffing box is provided with a screwed gland and spring-loaded gland follower.

A deep-groove heavy-duty ball bearing takes the combined thrust and radial load and the bearing mounting serves as a water slinger. The new pump is available in capacities up to 1,100 gallons per minute and heads to 350 feet.



Flexi-unit industrial centrifugal pump with nonclogging impeller

Rock-Wool Pipe Insulation

SUITABLE FOR TEMPERATURE up to 1,250 deg. F., the new Gimco "Savall" rock-wool pipe insulation now being offered by the General Insulating & Manufacturing Company, Alexandria, Ind., is made entirely of rock wool without artificial binders. The insulation is formed into hinged

Gimco "Savall" rock-wool pipe insulation

sections of standard length and diameter for easy application by slipping into place and fastening on with bands.

Some of the claims made for the insulation by the manufacturer are, that, owing to the natural tendency of the resilient fibers of rock wool to intermingle, it tends to seal the joints perfectly, where the end of each section join and where the edges of the hinge and joint come together. It has sufficient elasticity to absorb the expansion and contraction of the pipe without becoming loose; pipe fittings and joints imbed themselves in the wool without necessity of cutting out for such fittings; sections can be removed and replaced several times without injury or loss of efficiency; and the material is not affected by climatic conditions.

It is furnished in 36-in. sections in a wide range of pipe sizes and insulation thicknesses.

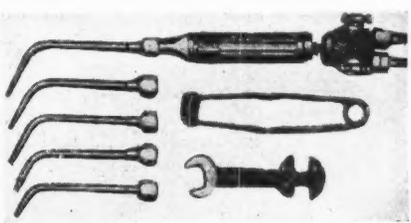
New Style Powercoater for Boiler Tubes

A NEW STYLE POWERCOATER, to be used in the application of the protective coating "Apexior," to the internal tube surfaces of water-tube boilers, has been announced by the Dampney Company of America, Hyde Park, Boston, Mass.

When coating straight tubes, the powercoater is attached to a standard tube cleaner with a rigid coupling, and a universal coupling is used for bent tubes. The powercoater consists of two short arms mounted in a circular base, which open out in a V-formation by centrifugal force. There are two removable bristle brushes with die-cast backs fastened to the ends of the arms by means of pins. The freedom of movement of the arms in the base, and of the brushes on the arms, allows for the adjustment of the brushes to the surface of the tube, as the powercoater is rotated. The brushes pick up the coating liquid which has previously been deposited in the tube, and brush and scrub it into the surface of the metal.

Two New Welding Blowpipes

TWO NEW WELDING BLOWPIPES, Types W105 and W106, have recently been added to the line of torches put out by the Linde Air Products Company, 30 East 42d St., New York, N. Y. A detachable valve body, to which the handle is secured by a simple and convenient locking device, enables the operator to change



Type W106 welding blowpipe

quickly from the standard to different handles without detaching hose or hose connections and without the use of a wrench.

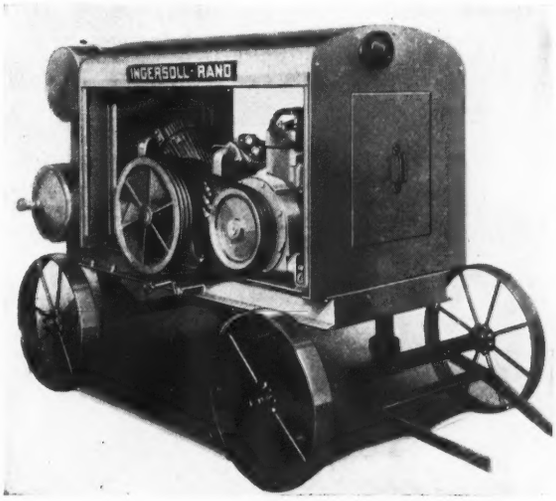
Both blowpipes are designed for use with the new type one-piece, hard-drawn copper welding tips. Although regularly supplied with a head angle of 60 deg., this may be changed by the user to any angle desired. Ten different sizes of tips, Nos. 4 to 13, inclusive, are available for use with the Type W105 handle. A stem adaptor is available, so that tips for the Type W107 welding blowpipe may be used with Type W105. This makes the new blowpipe adaptable for work ranging from the lightest sheet metal welding to heavy welding work requiring a No. 13 tip.

The W106 blowpipe is similar in design to the Type W105, but smaller. It is supplied with five sizes of tips, Nos. 3 to 7, inclusive, and is particularly suited to general light welding, bronze-welding small parts, and for soldering. A stem adaptor is available so that type W107 tips may be used with the Type W106 handle.

Small Portable Air Compressor

A SMALL PORTABLE AIR COMPRESSOR, designated type 30, with a capacity of 30 cu.ft. per minute, is a recent addition to the line of air-compressing equipment put out by the Ingersoll-Rand Company, 11 Broadway, New York City.

The compressor is a standard I-R two-stage, air-cooled, ball-bearing unit equipped with plate valves, fan-type pulley sheave and finned copper tube intercooler. It is driven by a Fuller Johnson four-cylinder four-stroke - cycle ball - bearing engine through a V-belt. The unit is equipped with air cleaners, automatic unloader and governor. A 16 x 40-in. air receiver and a 12-gal. gasoline tank are mounted on the frame at the rear.



Portable, two-stage, air cooled, ball bearing air compressor of 30 cu.ft. capacity

NEWS of the FIELD

Program Announced for Fourth Meeting of A.S.M.E. Oil and Gas Power Division

Live technical papers and equipment exhibit, features of gathering at University of Wisconsin on June 23-26

PROGRAM DETAILS have just been announced for the fourth national meeting of the Oil and Gas Power Division of the American Society of Mechanical Engineers, which will be held at the University of Wisconsin, Madison, on June 23 to 26, inclusive. Eighteen live technical papers, a comprehensive exhibit of oil- and gas-power equipment, inspection trips and social events are among the features scheduled on the program.

All technical sessions will be held in the new engineering building, which has recently been completed at the university. The laboratory in this building, accommodating engine of large size, will be used for the exhibit. Preliminary reports from the committee on exhibits indicate that the display of engines and accessories this year will surpass those shown at previous meetings.

The meeting will be opened at 2 p.m., on Tuesday, June 23, by Ben G. Elliott, chairman of the committee on arrangements. Three papers will be presented at this session, as follows: "Dispersion of Oil Sprays," K. J. DeJuhasz; "A Quiescent Combustion Chamber," J. A. Spanogle; and "Experiments on the Flow of Air Through Engine Valves," E. S. Dennison and T. C. Kerchlee. Formal opening of the exhibit will take place after the first session, followed in the evening by an informal get-together party with special entertainment.

At the three sessions on Wednesday the following papers will be given: "How to Select a Diesel Engine," Otto Nonnenbruch; "Development of a High-Speed L-Head Diesel Engine," Max Hoffman; "Development of Double-Acting Diesels," Louis R. Ford; "Present Position of the Automatic Diesel Plant," Edgar J. Kates; "Diesel Municipal Light Plants in the Middle West," C. F. Lambert; "Observation of European Diesel Developments," John O. Huse; "European Trends in Diesel Design," O. F. Allen; "Diesels for Motor Trucks," contributed by the Verein Deutscher Ingenieure, and reports of the committees on Diesel fuel research and oil-engine power cost.

Two papers—"Application of Oil Engines to Ship Propulsion," A. J. C. Robertson, and "Light-Alloy Pistons and Rods in High-Speed Industrial Engines," B. J. Isidin—will be read on Thursday morning, followed by an inspection trip to the Fairbanks, Morse & Company works, where visitors will be served lunch. In the evening the annual banquet and dance will be held in Memorial Union.

On Friday the meeting will close with the morning session, at which the following papers will be presented: "Piston-Packing Problems," C. K. Sencebaugh; "Outstanding Municipal Diesel Plants," C. Ruegg; "Heat Recovery from Internal-Combustion Engines," Thomas Clarkson and William Bradford. After the close of the meeting a special trip will be arranged for all those interested to Milwaukee industrial plants and the Grand Haven diesel power plant.

Stoker Manufacturers Meet in New York City

AT THE ANNUAL MEETING of the Stoker Manufacturers Association in New York City on May 15, Joseph G. Worker, of the American Engineering Company, was re-elected president; R. C. Goddard, of Combustioneer, Inc., was elected vice-president and F. H. Daniels of the Riley Stoker Corporation, treasurer. F. R. Low, editor emeritus of *Power*, was elected an honorary member of the association at a full meeting of the executive committee.

Mr. Worker reported that stoker sales were holding up to the 1930 level, sales of mechanical stokers in the United States for the first quarter of 1931 being exactly 100 per cent of the sales for the first quarter of 1930 and about 75 per cent of those for the first quarter of 1929.

It was voted that the association should serve the public more efficiently by further development of stokers for burning coal in the home. The work of the Committee of Ten, composed of representatives of national organizations who are cooperating to collect and interchange educational data pertaining to the burning of coal of both large and household stokers, was endorsed.

The executive committee adopted the recommended setting heights for heating boilers equipped with mechanical stokers, prepared by the Mid-West Stoker Association, as a guide for architects and consulting engineers in determining the headroom requirements for heating plants.

The Fall meeting will be held in Atlantic City in October.

Plan Fifth Project On Kootenay River

FORMAL APPLICATION for a permit to develop its fifth power site on the Kootenay River in British Columbia, was made recently at Victoria, by the West Kootenay Power & Light Company, subsidiary of the Consolidated Mining & Smelting Company. If plans materialize a plant will be erected at Brilliant, B. C., to develop around 30,000 hp. and complete the harnessing of the entire flow of the Kootenay.

The plants already either in operation or under construction by the company impound the entire flow of the river from Kootenay Lake to the South Slocan power site, and the new plant will take care of the remainder of the flow to the Columbia River.

Three other developments are now under way in British Columbia by this company. The first of these is at Cora Lynn, near Nelson; a second is that of the Pend Oreille scheme, the largest in Western Canada; and the third is on the Adams River, east of Kamloops.

A.I.&S.E.E. Convention In Cleveland, June 15-19

THE ANNUAL CONVENTION of the Association of Iron & Steel Electrical Engineers will be held this year in Cleveland, Ohio, from June 15 to 19 inclusive. Business sessions, committee reports and inspection trips are scheduled on the program, together with a special symposium of the wire and wire-products division. As in past years, a feature of the meeting will be the Iron & Steel Exposition, which will be open daily in the Cleveland Public Auditorium.

Among the committee reports and subjects to be discussed at the business

sessions are: Electrical developments, arc welding, standardized symbols for control apparatus, application of health lamps to the iron and steel industry with respect to efficiency and welfare, report of the special committee on bearings, motor and control equipment for cold-strip mill drives, twin motor drives, combustion control apparatus for open hearth furnaces, lubrication engineering committee reports and electrical generating equipment.

Other events on the program include inspection trips to the power plants of the Goodyear Tire & Rubber Company and the dirigible "Akron," the world's largest airship informal and formal receptions, and a boat excursion on Lake Erie.

Canadian Electrical Assoc. To Meet at Banff, June 16-18

AN IMPORTANT FEATURE of the 41st annual convention of the Canadian Electrical Association, which will be held at the Banff Springs Hotel, Banff, Alberta, on June 16 to 18, will be the meeting of the engineering section. At this meeting recent developments will be reviewed in report of the committees on electrical apparatus, hydraulic power, inductive coordination, power systems, meters and lamps.

The report of the electrical apparatus committee will cover such topics as electric boiler operation, automatic hydro-electric stations, fire protection of large oil-filled equipment and new developments in 1930. The hydraulic committee report will discuss operating troubles with mechanical and hydraulic equipment in hydro-electric stations, the painting of under-water structures and protection of iron and steel surfaces. Automatic frequency control and suggestions for the improvement of system frequencies will be covered in the report of the power systems committee, while the meter, lamp and inductive coordination committees will review progress in their respective fields.

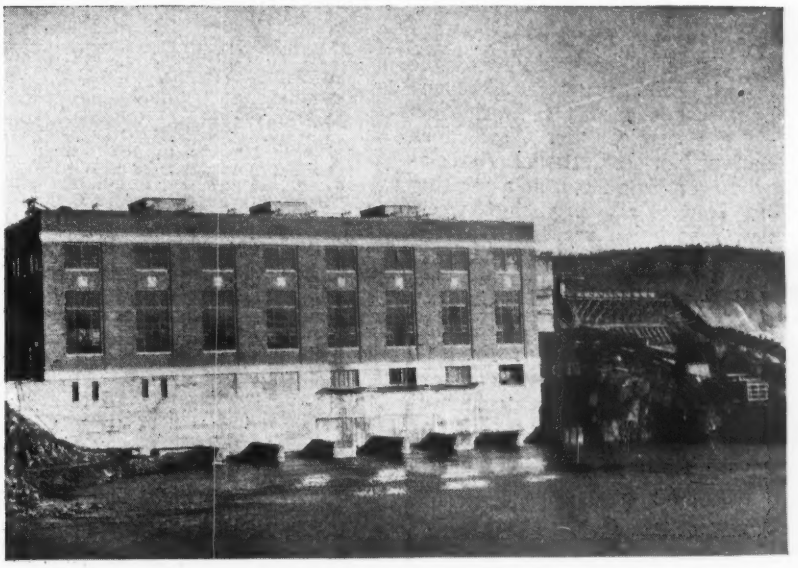
Executive and committee sessions, meetings of the commercial and public relations sections, as well as a full quota of interesting entertainment features are among the other events on the program of the convention as a whole.

More Loeffler Boilers Added to European Plants

SEVERAL new European installations of Loeffler boilers are now under construction. Two units, each of 150,000 lb. per hour capacity, will be put in service in June at the Caroline Pit station in Moravska-Ostrava. Three similar units will be started in the course of 1932 in the new Trebovice central station of the Electricity Works of Moravska-Silesia in Czechoslovakia. Several smaller Loeffler boilers have been delivered recently to technical universities in Europe.

It will be recalled that the Loeffler boilers generates steam without exposing any water-heating surfaces to the radiant heat of the furnace, or to hot gases. Furnace heat is delivered solely to a large superheater and an economizer. Steam is forced through the superheater by a reciprocating pump, and then through water, where the superheat is given up to generate additional steam, which follows around the same circuit. The excess steam produced is tapped off for power or process after superheating.

ALEXANDER PLANT COMPLETED



The second to be constructed on the Nipigon River by the Ontario Hydro-Electric Power Commission, Alexander plant has a total capacity of 54,000 hp. in three 18,000-hp. francis-type units operating under a normal head of 60 ft. The first plant at Cameron Falls, about 1.5 miles above Alexander, has a capacity of 75,000 hp. in six 12,500-hp. units. At present Alexander station has its own control room, but eventually it will be controlled remotely from the Cameron Falls plant. Power from these plants supplies the cities of Port Arthur and Fort William, about 80 miles away

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B. G. Worth, Vice-President, Walter Kidde & Co., Dies

BARZILLAI G. WORTH, vice-president of Walter Kidde & Company, of New York City, and chief engineer in charge of power-plant design and development for the company, died on May 25 at the Fifth Avenue Hospital in New York. He was 51 years old, and lived at West Orange, N. J.

Mr. Worth was a descendant of Major-General Worth of Mexican War fame. He was graduated from Stevens Institute of Technology in 1901, and had been with Walter Kidde & Company since that time, during which he was prominently identified with the design and construction of power plants.

He was a member of the American Society of Mechanical Engineers and a fellow of the American Institute of Electrical Engineers.

Save 70% of California Waste Gas in First Quarter

A DECREASE of 70 per cent in wastage of natural gas in California during the first quarter of this year as compared with the corresponding period of last year is shown in a report just submitted to the state Railroad Commission by Claude C. Brown, gas and electric engineer. According to the report, natural gas production for the first three months of 1931 amounted to 106,502,000,000 cu.ft., utilization totaled 84,825,000,000 cu.ft. and wastage was 21,677,000,000 cu.ft. Corresponding totals for 1930 are: production, 156,039,000,000 cu.ft.; utilization, 83,649,000,000 cu.ft.; and wastage, 72,390,000,000 cubic feet.

Decreases in the amount produced and the amount wasted, which are 32 per cent and 70 per cent respectively, are the direct result of the activities of those interested in the conservation of natural gas in California, including the Railroad Commission, which has since 1927 been actively engaged in cooperation with the public utilities, the oil industry and the Department of Natural Resources, in reducing the tremendous wastage that heretofore existed. These efforts, it is stated, have resulted in increasing the utilization from 54 per cent, in the first quarter of 1930, to 80 per cent, in the first quarter of 1931, and in reducing the wastage from 46 to 20 per cent.

Sales of gas to the public utility distribution companies was increased from 36,471,000,000 cu.ft. in the first quarter of the year 1930, to 43,357,000,000 cu.ft. in the first quarter of 1931.

Wilds Heads Consolidated N. A. P. E. in New York

H. W. WILDS, chief engineer of the New York Life Insurance Company Building, was elected the first president of the new Greater New York Association No. 1, National Association of Power Engineers, at a meeting held in New York City, last week. The new association represents a consolidation of five subordinate associations of the N.A.P.E. in the city. Fred W. Raven, national secretary, officiated at the installation ceremonies.

Other officers elected are: Fred G. Vilmo, vice-president, chief engineer Pratt Institute; W. T. Meinzer, recording secretary, chief engineer Flushing Hospital; A. N. Brent, corresponding secretary, chief engineer Susquehanna Silk Mills Building; Henry Schneider, financial secretary, chief engineer Vincent Astor Estates; Fred Schultz, treasurer, engineer Warner Brothers.

The primary aim of the association during the next year, according to Mr. Wilds, will be to further the education of its members and to assist in the preparation and enactment of laws which will prevent loss of life and property in the generation and transmission of power. Educational classes for members, which will be addressed by prominent figures in the engineering profession, will be held at regular intervals throughout the year, he said.

Edward D. Adams, Pioneer in Niagara Development, Dead

EDWARD DEAN ADAMS, financier and engineer, who was a pioneer leader in the development of hydro-electric power at Niagara Falls, died on May 20 at his home in New York City, as a result of injuries received in an automobile accident on March 29, while on his way to visit Thomas A. Edison in Fort Myers, Fla. He was 85 years old.

During 54 years in business Mr. Adams was director or officer in more than 40 banks or corporations engaged in transportation, manufacture, power development or other engineering enterprises. At various times he was closely associated with Thomas A. Edison in electrical development, and with scientists and engineers all over the world in hydro-electric projects.

He was born in Boston, Mass., on April 9, 1846, and was educated at Norwich University and the Massachusetts Institute of Technology. The recipient of many foreign decorations, honors and degrees, including the John Fritz Gold medal, 1926, he was a trustee, fellow or member in numerous organizations, a few of which are: American Institute of Electrical Engineers, United Engineering Trustees, Inc., World Engineering Congress, American Association for the Advancement of Science, American Electro-Chemical Society and the Engineers Club of New York.

COMING CONVENTIONS

American Society of Mechanical Engineers. National Oil and Gas Power Meeting at the University of Wisconsin, Madison, Wis., June 23-26. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineer. Annual summer convention in Asheville, N. C., June 22-26. District meeting at Lake Tahoe, Calif., Aug. 25-28. Secretary, F. L. Hutchinson, 33 West 39th St., New York.

American Society of Heating and Ventilating Engineers. Semi-annual meeting at the New Ocean House, Swampscott, Mass., June 22-26. Secretary, A. V. Hutchinson, 51 Madison Ave., New York City.

American Society for Testing Materials. Annual meeting at the Stevens Hotel, Chicago, Ill., June 22-26. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Iron and Steel Electrical Engineers. Annual meeting and exposition at the Cleveland Public Auditorium, Cleveland, Ohio, June 15-19. Managing director, John F. Kelly, Empire Building, Pittsburgh, Pa.

National Association of Power Engineers. Annual convention and mechanical exposition in the Convention Hall, Kansas City, Mo., Sept. 7-11. Secretary, Fred W. Raven, 417 South Dearborn St., Chicago.

Third International Conference on Bituminous Coal. At Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 16-21. Chairman, Thomas S. Baker, president of Carnegie Institute of Technology.

Universal Craftsmen Council of Engineers. Annual convention at the Sherman Hotel, Chicago, Ill., Aug. 4-8. Secretary of Convention Committee, James J. Blaine, 7342 Harvard Ave., Chicago, Ill.

Harrington Emerson, Noted Efficiency Engineer, Dies

HARRINGTON EMERSON, president of Emerson Engineers from 1900 to 1923, died on May 23 at his home in New York City, at the age of 76 years. He was widely known as an efficiency expert, and the "Lessons in Personal Efficiency" he prepared are said to have been studied by 50,000 students.

Born in Trenton, N. J., Mr. Emerson was educated at the Royal Bavarian Polytechnic. After six years as professor of modern languages at the University of Nebraska, he entered business, and eventually established his own firm of industrial efficiency engineers. His efficiency methods first became widely known through the results achieved on the Santa Fe Railroad.

He wrote several books and gave many lectures on his specialty. He belonged to various engineering societies and clubs, including the American Society of Mechanical Engineers, Society of Industrial Engineers and the Engineers Club of New York.

Personals

ERIC H. EWERTZ, consulting welding engineer of New York City, has been awarded the Samuel Wylie Miller Memorial Medal for 1930 "for his pioneering in the development and application of arc welding." Mr. Ewertz became interested in electric arc welding in 1912, and was the first to utilize it successfully in applications to marine construction work.

JOHN M. LESSELLS, formerly manager of the mechanics division of the Westinghouse research laboratories, has been appointed manager of engineering in the South Philadelphia works of the company, to succeed A. D. HUNT, resigned. Mr. Lessells, a native of Scotland, has been with the Westinghouse organization since 1920. Another new appointment in the company is that of FRANK THORNTON, JR., formerly of the general engineering department, who has been made manager of association activities to succeed R. W. E. MOORE, resigned.

DR. HAROLD B. SMITH, for 35 years head of the department of electrical engineering at Worcester Polytechnic Institute, has announced his retirement, effective in June. One of the best known figures in engineering and educational circles, Professor Smith served as president of the American Institute of Electrical Engineers in 1929. He plans to take an extended rest before resuming professional practice. Prof. JOSEPH O. PHELON will also retire from the electrical engineering department at Worcester in June, following 44 years of service at the institute.

JAMES O. G. GIBBONS, consulting engineer of Newark, N. J., has moved his office from 207 Market St. to 45 Clinton Street.

J. F. OWENS, vice-president and general manager of the Oklahoma Gas & Electric Company, has been elected president of the company to succeed JOHN J. O'BRIEN, president of the Byllesby Engineering & Management Corporation and the Standard Gas & Electric Company, who has also been serving as president of most of the affiliated companies. Others elected as officers of the Oklahoma company are: W. R. EMERSON, vice-president and treasurer; FRANK J. MEYER, vice-president in charge of operation; GEORGE ADE DAVIS, vice-president in charge of public relations; and B. M. LESTER, secretary.

WILLIAM H. BARTON, for the past several years manager of the customers' department of the Northwestern Electric Company and Portland Gas & Coke Company, Portland, Ore., has been appointed general manager of the gas division of the Montana Power Company, which distributes natural gas in ten cities of Montana, with headquarters in Butte.

Business Notes

BALDWIN LOCOMOTIVE WORKS. Philadelphia, Pa., has purchased the subsidiary companies of CRAMP MORRIS INDUSTRIALS, INC. These include I. P. MORRIS & DE LA VERGNE, INC., Philadelphia; DE LA VERGNE ENGINE COMPANY, Philadelphia; PELTON WATER WHEEL COMPANY, San Francisco; CRAMP BRASS & IRON FOUNDRIES COMPANY, Philadelphia; and FEDERAL STEEL FOUNDRIES COMPANY, Chester, Pa.

PORTABLE MACHINERY COMPANY, Clifton, N. J., will be operated in the future as a division of the A. B. FARQUHAR COMPANY of York, Pa., it is announced. No change is contemplated in the management of the Portable Machinery Company, but its main offices and factory will be moved to York, a branch factory and service station being maintained at the present location in Clifton.

FAIRBANKS, MORSE & COMPANY, Chicago, Ill., announce the appointment of R. H. Bacon, former advertising manager of the company, as manager of its pump sales division. Mr. Bacon, who has been associated with the company since 1925, will maintain headquarters in Chicago.

THE COMMITTEE OF TEN OF THE COAL AND HEATING INDUSTRIES has established general administrative headquarters, and the NATIONAL COAL ASSOCIATION has established its Western office at 1715 Bell Bldg., 307 North Michigan Ave., Chicago, Ill. Oliver J. Grimes is in charge of the office for both organizations.

ROLLER-SMITH COMPANY, New York City, announces the appointment of the Commercial Engineering Company, 1800 East St., N.W., Washington, D. C., as its sales agent in the District of Columbia.

DAYTON-DOWD COMPANY, Quincy, Ill., announces that M. B. MacNeille has joined its sales organization as Western sales manager with headquarters in San Francisco, Calif. Mr. MacNeille has been connected with the pump division of FAIRBANKS, MORSE & COMPANY for the past nineteen years, in the capacities of designing engineer on centrifugal pumps, chief engineer of the hydraulic division and manager of the pump division.

BLAW-KNOX COMPANY, Pittsburgh, Pa., has acquired from the American Tractor & Equipment Company of Oakland, Calif., the exclusive sales and manufacturing rights to the ATECO line of earth-moving machinery, for the United States east of the Rocky mountians and for all other countries.

MINNEAPOLIS - HONEYWELL REGULATOR COMPANY, Minneapolis, Minn., announces the removal of its Chicago office from 672 Wrigley Bldg. to 2065 Daily News Bldg., 400 West Madison Street.

How's Business?

THE WEEK-TO-WEEK changes in the composite picture of production, construction and trade activity as represented in our index continue small, confirming the increasingly clear conclusion that business has reached its resistance level. The first three weeks of May show a slight shading-off from the Spring peak of the preceding two months, but the full April records clinch the evidence of improvement in fundamental factors since the beginning of the year. Production volume has increased slowly for four successive months, supported especially by lines involving consumer goods rather than capital goods. Trade volume, as reflected in department store sales, bank debits and merchandise carloadings, showed a definite rise in April. Business failures have apparently passed their peak, as they always do when business volume begins to increase. Construction is the conspicuous laggard and is depressing steel despite encouragingly steady automotive activity.—*The Business Week*, June 3.

Trade Catalogs

PUMPS—Full information on the company's line of deep-well turbine pumps for industrial, municipal and irrigation service together with engineering data of special value to water users, is contained in a 96-page illustrated reference catalog just issued by the Layne & Bowler Corporation, 900 Santa Fe Ave., Los Angeles, Calif.

BEARINGS—The Timken Roller Bearing Company, Canton, Ohio, has recently issued a revised edition of its "Engineering Journal," containing information relative to the manufacture, ratings and dimensions of roller bearings, bearing selection, shaft and housing design, mountings, installation and inspection of bearings. The publication contains 138 pages with many diagrams and tables.

REGULATORS AND VALVES—Full information on the Spence line of pressure and temperature regulators, expansion and control valves is contained in the new illustrated catalog issued by the Spence Engineering Company, 110 East 42nd St., New York City. Charts and tables showing the capacity of the regulators are given in the catalog, together with typical flow-meter records taken on actual installations.

ELECTRICAL INSULATION TESTING—The third revised edition of "Pocket Manual of 'Megger' Practice" (No. 1150) has just been published by the James G. Biddle Company, 1211 Arch St., Philadelphia, Pa. The book contains valuable data on the characteristics of electrical insulation and the testing of insulation resistance. It suggests how and where to look for insulation defects and gives full directions for using the company's instruments to detect and forestall trouble in nearly all types of electrical equipment. The manual contains 96 pages, 67 illustrations, and is priced at 25 cents.

SPRAY NOZZLES—Schutte & Koerting Company, 12th and Thompson Sts., Philadelphia, Pa., has just issued a new bulletin, No. 6-A, describing and illustrating a complete line of spray nozzles for water, oil and other liquids used in industrial processes and power plants.

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Fuel Prices

FUEL OIL

Boston—May 25, tank-car lots, f.o.b. 12@14 deg. Baumé, 2.91c. per gal.; 28@32 deg., 4.85c. per gal.

New York—May 21, f.o.b. Bayonne, N. J., 28@34 deg. Baumé, industrial use, tank-car lots, 4.5c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6c. per gal.

Philadelphia—May 20, No. 3, industrial gas oil, $1.83 per bbl.; No. 4, light industrial fuel oil, $1.31 per bbl.; No. 5, medium industrial fuel oil, $1.20 per bbl.; No. 6, heavy (Bunker C), $1.05 per bbl.

Pittsburgh—May 20, f.o.b. local refinery, fuel oil, 30@34 deg., 2.625c.@2.875c. per gal.; 36@40 deg., 2.625c.@2.875c. per gal.

Cincinnati—May 26, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 4.5c. per gal.; 26@30 deg., 4.75c. per gal.; 30@32 deg., 5c. per gal.

Chicago—May 18, tank-car lots, f.o.b. Oklahoma; freight to Chicago, 90c. per bbl. or 42 gal.; 18@22 deg., 37.5c. per bbl.; 22@24 deg., 42.5c. per bbl.; 24@26 deg., 45c. per bbl.; 26@28 deg., 55c. per bbl.; 28@30 deg., 65c. per bbl.

St. Louis—May 27, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.17 per bbl., or 42 gal.; 26@28 deg., $1.27 per bbl.; 28@30 deg., $1.345 per bbl.; 30@32 deg., $1.445 per bbl.; 32@36 deg., gas oil, 2.651c. per gal.; 38@40 deg., distillate, 3.526c. per gal.

Dallas—May 23, f.o.b. local refinery 24@26 deg., 95c. per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol.	New York	$1.70 @ $1.90
Pool 10, h. gr. low-vol.	New York	1.60 @ 1.70
Pool 11, low-vol.	New York	1.40 @ 1.50
Smokeless, mine-run	Chicago	1.50 @ 1.75
Smokeless, slack	Chicago	60 @ 1.25
Harlan, Ky., slack	Chicago	1.10 @ 1.20
Franklin, Ill., mine-run	Chicago	2.15
Franklin, Ill., screen	Chicago	1.50 @ 1.75
Ind. 5th Vein, m.-r.	Chicago	1.20 @ 1.75
Standard Ill., mine-run	St. Louis	1.25 @ 1.40
W. Ky., mine-run	Louisville	.85 @ 1.25
W. Ky., slack	Louisville	.70 @ .80
Pittsburgh, mine-run	Pittsburgh	1.35 @ 1.45
Smokeless, mine-run	Cincinnati	1.65 @ 1.75
Smokeless, slack	Cincinnati	1.00 @ 1.25
Kanawha, mine-run	Cincinnati	1.10 @ 1.35
Kanawha, nut-slack	Cincinnati	.75 @ 1.15
Anthracite (Net Tons)	**At Mine, for Shipment to**	**Price per Ton**
Buckwheat	New York	$3.25 @ $4.00
Barley	New York	1.00 @ 1.40

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Napa—City plans the construction of a waterworks pumping plant and pipe line to provide water for Browns Valley Section. $15,000.

Calif., Stockton—State of California, is having plans prepared for the construction of a kitchen and refrigeration plant at State Hospital. Estimated cost $118,000. P. Sala, 2130 North Commerce St., is architect.

Conn., Willimantic — Windham County Memorial Hospital, G. E. Taylor, Chn., is having preliminary estimates made for the construction of a hospital, nurses' home, power plant, laundry, etc., at West Main and Mansfield Sts. Estimated cost $500,000. Crow, Lewis & Wick, 200 5th Ave., New York, N. Y., are architects. C. S. Neergard, 512 5th Ave., New York, is engineer.

Ind., Crawfordsville — City awarded general contract for the construction of a power plant to include 950 hp. water tube boiler with superheater, soot blower and forced draft chain grate stoker to Pickett & Gill, 420 Continental Bank Bldg., Indianapolis. Estimated cost $60,000.

Ind., Fort Wayne—Bd. of Public Works, will receive bids until June 2 for sewage treatment plant including pump houses, etc. Estimated cost $40,000.

Ind., Fort Wayne — St. Vincent's Orphans Home, will receive bids until June 10 for the construction of a home, including school building, power plant, equipment, at Wells St. and Archer Ave. Estimated cost $500,000. A. M. Strauss is architect. R. W. Roland is engineer.

Ind., Garrett—City will receive bids until June 15 for the construction of 22 x 74 ft. addition to power plant. Estimated cost $42,000. A. M. Strauss, 415 Cal-Wayne Bldg., is engineer. Equipment will be required.

Ind., Shelbyville—C. C. Shipp & Co., 212 Castle Hall, Indianapolis, awarded contract for a hydro-electric plant on Flat Rock River near here. Plans include power house, dam, 238 ft. long and 20 ft. high, retaining wall, 850 ft. and spillway, 147 ft., to J. G. Karstedt, 632 Architects Bldg., Indianapolis. $76,984.

Ind., Wabash—Eagle Lodge, awarded contract for the construction of a 2 story, 44 x 65 ft. steam heating plant and equipment to F. Webb, 242 West Market St. Estimated cost $25,000.

Mass., Gardner — Commonwealth of Mass., Dept. of Mental Diseases, is having plans prepared for the construction of a heating plant for Hospital. Estimated cost $150,000. A. B. Franklin Inc., 25 Haverhill St., Boston, is engineer.

Mass., Methuen—Town, c/o A. A. Thompson, Town Hall, plans the construction of a municipal power plant. Estimated cost $50,000. Engineer not selected.

Mass., New Bedford—Holmes Coal Co. Inc., Pine St., plans the construction of a coal handling plant, including hoisting tower and power house. Estimated cost to exceed $40,000. Private plans.

Mass., Taunton—Dept. of Mental Diseases, plans boiler room improvements at State Hospital. Estimated cost $45,000. Engineer not selected.

Mass., Woburn—City will soon award contract for extension to water supply system, including new wells, pumps, etc. Estimated cost $110,000. Metcalf & Eddy, Statler Bldg., Boston, are engineers.

Mich., Bay City—City plans the construction of a pumping plant in connection with sewage treatment work. Estimated cost $250,000. Menefee & Dodge, Ann Arbor, are engineers.

Mo., St. Louis—Syndicate of New York and Pittsburgh Interests, c/o Boyer & Armstrong, Arcade Bldg., St. Louis, is having sketches made for the construction of a 40 story office building at Broadway, between Olive and Pine Sts. Estimated cost $2,500,000.

Neb., North Platte — Northwestern Public Service Co., T. T. Parker, 712 Bankers Life Bldg., Omaha, awarded contract for the construction of a high pressure steam power plant including installation of equipment on North Platte River to Peter Kiewit's Sons, 911 Omaha National Bank Bldg., Omaha. Estimated cost $500,000.

Neb., Sargent—Mayor and Council, plans the construction of a 5 ton electrically driven ice plant and building. Estimated cost $12,000. Bids on equipment will be received Oct. 1.

Neb., Sutherland—City, P. N. McKinley, Clk., awarded contract for the construction of a 1 story, 32 x 90 ft. power plant to Fairbanks-Morse Co., 9th and Harvey Sts., Omaha. Estimated cost $40,000.

N. J., Convent Station—St. Elizabeth's College Sisters of Charity, awarded contract for the construction of a 68 x 95 ft. power house to E. M. Waldron, Inc., 40 Park Pl., Newark. Estimated cost $40,000.

N. J., Hackensack — Bd. of Chosen Freeholders, J. M. Harkness, Clk., Court House, will receive bids until July 3 (extended date) for the construction of a 4 story administration building, including steam heating and ventilation systems, boilers, elevators, etc., at Main and Hudson Sts. Estimated cost $1,200,000. Filton, Schwanewide & Githens, 420 Lexington Ave., New York, N. Y., are architects.

N. J., Hawthorne—Sands Bros., 1099 Goffle Rd., plans to rebuild a 2 story ice plant at Goffle and Rock Rds. destroyed by fire. Estimated cost $40,000. Architect not selected.

N. J., Jersey City—Public Service Electric & Gas Co., 80 Park Pl., Newark, awarded contract for the construction of a 33 x 72 ft. gas pumping station, including three large steam driven centrifugal compressors on St. Pauls Ave., to United Engineers & Constructors, Inc., 80 Park Pl., Newark, $40,000.

N. M., Albuquerque—U. S. Veterans' Bureau, H. L. Tripp, Ch. Construction Div., 764 Arlington Bldg., Washington, D. C., will soon award contract for the construction of a group of buildings, including ice-making and refrigeration plant, water softening system, etc., at U. S. Veterans' Hospital here. Estimated cost $1,250,000.

N. Y., Brooklyn—Brooklyn & Queens Transportation Co., 385 Flatbush Ave., will receive bids in June (extended time), for the construction of a sub-station at Ocean Ave. and Ave. H. Estimated cost $45,000. H. J. Kolb, 385 Flatbush Ave. Ext., is engineer.

N. Y., New York — Bd. of Transportation, awarded contract for the construction of 10th St. sub-station, part of rapid transit railroad to G. H. Haley Co., 60 East 42nd St. Estimated cost $21,700.

N. Y., Poughkeepsie—New York Power & Light Corp., subsidiary of Niagara Hudson Power Co., 117 Liberty St., New York, will soon receive bids for the construction of a sub-station, 266,000 kva. capacity near here in connection with transmission line now under construction.

O., Berea (br. Cleveland)—W. J. Wefel, 5716 Euclid Ave., Cleveland, Archt., is receiving bids for two 6 story apartment buildings, including steam heating system, elevators, etc., on Rocky River Dr., for Berea Square Co., c/o G. F. Williams, Rockefeller Bldg., Cleveland. Estimated cost $600,000.

O., Cleveland—Cleveland Arena Corp., c/o T. Conner, Hanna Bldg., Archt., is having preliminary plans prepared for the construction of a 1 story, 245 x 385 ft. sports arena at Euclid Ave. and East 30th to 40th Sts. Estimated cost $3,500,000.

Okla., Shawnee—City is having preliminary plans prepared for waterworks improvements including drilled wells and pumping equipment. Estimated cost $25,000. F. D. Brown, Shawnee, is engineer.

Okla., Stillwater—Oklahoma A. & M. College, P. S. Donnell, Dean, awarded contract for a 350 kw. 80% power factor turbine-generator unit to General Electric Co., River Rd., Schenectady, N. Y. $30,000.

Tex., Eagle Pass—Central Power & Light Co., Alamo National Bank Bldg., San Antonio, awarded contract for the construction of a 140 x 190 ft. power plant, 9,000 kw. capacity, here, to Bart Moore Inc., Milam Bldg., San Antonio. Estimated cost $300,000 complete.

Tex., Raymondville—State Bd. of Water Engineers, approved plans for irrigation project to include storage reservoir, 75,000 acre ft., pumping plant, etc., for Willacy Water Control & Improvement Dist. No. 1. Estimated cost $7,500,000. Morgan Engineering Co., Harlingen, is engineer. Construction started two years ago.

Ont., Clarksburg — Georgian Bay Fruit Growers, will soon award contract for the construction of a 70 x 70 ft. cold storage plant including refrigeration equipment. E. H. Darling, Piggott Bldg., Hamilton, is engineer.

N. F., St. Johns—United Towns Electric Co., will soon receive bids for the construction of a sub-station on Bell's Island. Estimated cost $100,000.

Ont., Hamilton—City, plans the construction of a sewage disposal plant, including pump house, etc. Estimated cost $623,000. W. L. McFaul, City Hall, is engineer.

Ont., Omemee—Town, plans the installation of a waterworks system including wells, pumping equipment, mains, etc. Estimated cost $40,000. A. W. Connor & Co., 106 Highland Ave., Toronto, are engineers.

Ont., Toronto—Ross & McDonald, 465 Bay St., Archts., are receiving bids for the construction of a hockey and sports arena, including steam heating and refrigeration systems, etc., for Maple Leaf Gardens Ltd., 13 King St. W. Estimated cost $1,250,000.

Que., Montreal — Montreal Light, Heat & Power Consolidated, plan the construction of a sub-station on Atwater Ave. Estimated cost $500,000.

Equipment Wanted

Accumulator Batteries—Melbourne, Australia—Posts and Telegraph Depts., will receive bids until July 7 for 20 accumulator batteries with various voltage capacity, 60 to 1,680 amp.

Boilers—Medfield, Mass.—Commonwealth of Mass., Dept. of Mental Diseases, plans the installation of new boilers at State Hospital. Estimated cost $40,000.

Electric Fan—Miami, Ariz.—Miami Copper Co., F. W. Maclennan, Mgr., plans to purchase a 100 hp. electric fan of 80,000 cu.ft. air capacity per minute.

Generator, Boiler, Stoker, Condenser, etc. — Macon, Mo. — Bd. of Public Works, L. T. Dameron, Jr., Secy., will receive bids until June 9 for a 750 kw. turbo-generator, 300 hp. water tube boiler, forced draft chain grate stoker, surface condenser with auxiliaries, etc.

Motors — New Orleans, La. — Sewerage and Water Board, B. Vallas, Gen. Supt., will receive bids until July 15 for two 450 and two 250 hp. vertical synchronous motors.

Pump—Anaheim, Calif.—City, E. B. Merritt, Clk., will receive bids until June 9 for furnishing and installing one deep well turbine pump, 1,000 g.p.m. against total head of 280 ft. or 1,500 g.p.m. against 200 ft. head for waterworks.

Pumps—Whittier, Calif.—City plans to purchase two horizontal centrifugal pumps direct connected to electric motors, air blower, etc., in connection with sewage disposal plant. Estimated cost $25,000.

Pumps—Morris, Minn.—City, J. A. Mielke, Mgr., will receive bids until June 15 for two 1,000 g.p.m. pumps for proposed waterworks improvements. Estimated cost $35,000.

Pumps—Grand Forks, N. D.—City will receive bids until June 10 for two 800 g.p.m. vertical multiple-stage turbine pumps with motors against total head of 54 ft., also two 800 g.p.m. vertical turbine pumps with motors against head of 12 ft. for waterworks.

Industrial Projects

Conn., Waterbury—Lux Clock Mfg. Co., 97 Sperry St., plans addition to electric clock manufacturing plant. Estimated cost $40,000. Architect not selected.

Mass., Everett — Merrimac Chemical Co., Chemical Lane, will soon award contract for the construction of a bi-sulphite plant. Estimated cost $40,000. Private plans.

O., Cleveland—McKinney Tool & Mfg. Co., A. McKinney, V. Pres., 1688 Arabelle Rd., is having preliminary plans prepared for a 1 story, 50 x 150 ft. addition to factory. Estimated cost $50,000. Private plans.

O., Dayton — Brown-Bruckmeyer Co. Inc., Norwood Ave., awarded contract for the construction of a 1 story, 90 x 500 ft. factory for the manufacture of small motors on Overlook St., to Henry Stock & Son, 55 Brandt St. Estimated cost $100,000.

O., Salem—Parmal Furniture Co., plans to rebuild 1 story factory on Newgarden St., recently destroyed by fire. Estimated cost $40,000. Private plans.

Pa., Scranton — Princeton Rayons Inc., 150 Madison Ave., New York, N. Y., is having preliminary plans prepared for the construction of a rayon factory here. Estimated cost $300,000.

Wis., Sheboygan—Plans and specifications are being made for the construction of a power plant for large furniture factory here. Ottomar H. Henschel, 401 Commerce Bldg., Milwaukee, is consulting engineer.

Ont., Hamilton—John Duff & Sons, Ltd., Hillyard St., awarded contract for the construction of a 75 x 150 ft. packing plant including steam heating and refrigeration systems to Frid Construction Co., Terminal Bldg. Estimated cost $125,000.

Ont., Willow Grove—Canadian Gypsum Co., H. O. 1221 Bay St., Toronto, awarded contract for the construction of a new plant, including 56 x 300 ft. sheet rock building, 50 x 156 ft. mill, 40 x 42 ft. machine shop, 50 x 175 ft. warehouse, etc., here, to W. H. Cooper, Lister Bldg., Hamilton.